ROCKFORD BOARD OF EDUCATION
INVITATION FOR BID ON SUPPLIES, MATERIALS, EQUIPMENT OR SERVICES FOR SCHOOL DISTRICT NO. 205 ROCKFORD, ILLINOIS

IFB No. **15-16 Auburn and Guilford High School Boiler Replacements**

DATE: **Thursday, November 6, 2014**

RE: **ADDENDUM NO. 1**

To All Bidders:

Attached are modifications, clarifications and/or corrections for the Project Manual and are hereby made a part of the contract documents. Please attach this addendum to the Project Manual(s) in your possession. Please note the receipt of this addendum on the bid form. Bidders shall review changes to all portions of this work as changes to one portion may affect the work of another.

PLEASE SEE ATTACHED REVISED SPECIFICATIONS FOR GUILFORD HIGH SCHOOL BOILER REPLACEMENT.

Refer all questions relative to the business aspect, Instructions to Bidders, Special Conditions, and questions concerning the technical aspect of the documents to the Purchasing Process Manager by email at tamara.pugh@rps205.com.

SECTION 220503 - PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:

1. Domestic water piping, above grade.
2. Sanitary sewer piping within 5 feet of building.
3. Sanitary sewer piping, above grade.
4. Equipment drains and over flows.
5. Unions and flanges.
6. Underground pipe markers.
7. Bedding and cover materials.

B. Related Sections:

1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
2. Section 22 07 00 - Plumbing Insulation: Product requirements for piping insulation for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.3 - Malleable Iron Threaded Fittings.
3. ASME B16.4 - Gray Iron Threaded Fittings.
4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
5. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
9. ASME B31.9 - Building Services Piping.
10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
11. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
8. ASTM B32 - Standard Specification for Solder Metal.
9. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
10. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

11. ASTM B75 - Standard Specification for Seamless Copper Tube.
12. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
13. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
14. ASTM B302 - Standard Specification for Threadless Copper Pipe.
15. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
16. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
17. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
18. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
19. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
20. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
21. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
22. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
23. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
24. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
25. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

C. American Water Works Association:

1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

D. Cast Iron Soil Pipe Institute:

1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

C. Shop Drawings: Provide 1/4” scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of buried piping with trenching.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

A. (Pipe size 3/4" - 6") - Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, Grade 95TA.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot ends.

1. Fittings: Cast iron, ASTM A74.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Ductile Iron Pipe: ASTM A746, service weight, bell and spigot ends.

1. Fittings: AWWA C110, ductile iron, standard thickness.
2. Joints: AWWA C111, rubber gasket joint devices.

C. PVC Pipe: ASTM D2665, Polyvinyl Chloride (PVC) material.

1. Fittings: ASTM D2665, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.

1. Fittings: Cast iron, ASTM A74.
2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hub-less, service weight.

1. Fittings: Cast iron, CISPI 301.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665, polyvinyl chloride (PVC) material.

1. Fittings: ASTM D2665, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
3. Note: PVC can be installed if allowed by local authority having jurisdiction.
4. Note: PVC piping is not allowed in mechanical return plenum ceilings. Refer to mechanical drawings for locations of return plenums.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
2. Joints: Threaded for pipe 2 inches and smaller.

B. Copper Tubing: ASTM B88, Type DWV, K, L, or M, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

C. PVC Pipe: ASTM D1785, Schedule 40.

1. Fittings: ASTM D2466, Schedule 40, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.5 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
4. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. PVC Piping: PVC flanges.
4. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.6 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil. thick, manufactured for direct burial service.

C. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Domestic Water Service or Sewer Service" in large letters.

2.7 BEDDING AND COVER MATERIALS

A. Bedding: Sand or fine gravel placed in layers of 6 inches maximum depth and compacted after each placement. Care shall be taken to thoroughly compact the backfill under and beside the pipe to ensure that the pipe is properly supported. Backfill shall be placed evenly on both sides of the pipe and tamped in a manner to retain proper alignment.

B. Cover: Refer to structural drawings or structural specifications for additional information.

C. Soil Backfill from Above Pipe to Finish Grade: Refer to structural drawings or structural specifications for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify excavations are to required grade, dry, and not over-excavated.

C. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert as indicated on Drawings.

B. Establish elevations of buried piping per drawings.

C. Install pipe to elevation as indicated on Drawings.

D. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches.

E. Install pipe on prepared bedding.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install shutoff and drain valves at locations indicated on Drawings in accordance with Section 22 05 23.

I. Install plastic ribbon tape continuous over top of pipe. Buried 6 inches below finish grade, above pipe line; refer to civil drawings or civil specifications for additional information. Refer to Section 22 05 53.

J. Pipe Cover and Backfilling:

1. Backfill trench: Refer to structural drawings or structural specifications for additional information.
2. Maintain optimum moisture content of fill material to attain required compaction density.

3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 6 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
5. Do not use wheeled or tracked vehicles for tamping

K. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

L. PVC shall not be used for any sanitary drainage piping capable of receiving waste with a temperature exceeding 120 degrees. PVC serving floor drains in mechanical room with boilers or water heaters will not be accepted.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 22 05 29.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.

G. Install non-conducting dielectric connections wherever jointing dissimilar metals.

H. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients unless noted otherwise on drawings.

I. Slope piping and arrange systems to drain at low points.

J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

K. Install piping penetrating roofed areas to maintain integrity of roof assembly.

L. Install valves in accordance with Section 22 05 23.

M. Install piping specialties in accordance with Section 23 21 16.

N. Insulate piping. Refer to Section 22 07 00.

O. Install pipe identification in accordance with Section 22 05 53.

P. Sleeve pipes passing through partitions, walls and floors.

Q. Plumbing contractor is responsible for all cutting and patching of existing walls/floor required to perform any new or demolition plumbing work.

R. PVC piping is not allowed in mechanical return plenum ceilings. Refer to mechanical drawings for locations of return plenum ceilings.

S. When PVC is used for sanitary applications, all vertical and horizontal piping shall be insulated.

T. PVC shall not be used for any sanitary drainage piping (below grade or above floor) capable of receiving waste with a temperature exceeding 120 degrees. PVC serving floor drains in mechanical room with boilers or water heaters will not be accepted.

U. All piping, fittings and joints shall comply with the Local Amendments and the Authority having Jurisdiction. Materials listed in specification that do not comply with these amendments shall not be used in the bidding process. It shall be the contractors responsibility to verify these adopted amendments.

3.5 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

A. Install domestic water piping system in accordance with ASME B31.9.

B. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.6 INSTALLATION - SANITARY WASTE AND VENT PIPING SYSTEMS

A. Install sanitary waste and vent piping systems in accordance with ASME B31.9.

B. Install sanitary waste and vent piping systems in accordance with Section 22 13 00.

C. Install bell and spigot pipe with bell end upstream.

D. Support cast iron drainage piping at every joint.

E. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test domestic water piping system in accordance with local authority having jurisdiction.

C. Test sanitary waste and vent piping system in accordance with local authority having jurisdiction.

3.8 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean and disinfect domestic water distribution system in accordance with Section 22 11 00.

END OF SECTION 220503

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors for application on equipment provided under other sections.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

1.5 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

A. Motors 3/4 hp and Larger: Three-phase motor as specified below.

B. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer’s standard.

C. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

1. Voltage: As indicated on Drawings.
2. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings.
3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Insulation System: NEMA Class B or better.
5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
6. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: Conform to NEMA MG 1.

D. Single Phase Motors:

1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
2. Voltage: 115 volts, single phase, 60 Hz.

E. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned motors

B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

B. Install engraved plastic nameplates in accordance with Section 26 05 53.

C. Ground and bond motors in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. Section 01 14 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION 220513

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves.
2. Ball valves.
3. Check valves.
4. Circuit balancing valves.

B. Related Sections:

1. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for pipe hangers and supports.
3. Section 22 07 00 - Plumbing Insulation: Product and installation requirements for insulation for valves.
4. Section 22 11 00 - Facility Water Distribution: Product and installation requirements for piping specialties and equipment used in domestic water systems.
5. Section 22 13 00 - Facility Sanitary Sewerage: Product and installation requirements for piping specialties and equipment used in sanitary waste and vent systems.

1.2 REFERENCES

A. American National Standards Institutes:

1. NSF/ANSI Standard 61 – Low Lead & Lead Free Brass.
2. NSF/ANSI Standard 61, Annex F – Low Lead & Lead Free Brass.
3. NSF/ANSI Standard 61, Annex G – Low Lead & Lead Free Brass.
4. NSF/ANSI Standard 372 – Low Lead & Lead Free Brass.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
2. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
3. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Shop Drawings: Provide 1/4” scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves.

C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install valves underground when bedding is wet or frozen.

1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two packing kits for each size valve.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. Manufacturers:

1. Apollo.
2. Milwaukee.
3. Nibco.

B. MSS SP-70, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends.

C. Sizes: 4 inches and larger.

D. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 - Low Lead & Lead Free Brass.

2.2 BALL VALVES

A. Manufacturers:

1. Apollo.
2. Milwaukee.
3. Nibco.

B. 3 Inches and Smaller, Construction: MSS SP-110, 600 psi, bronze, two piece body, stainless steel ball, full port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle and solder ends.

C. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 – Low Lead & Lead Free Brass.

2.3 CHECK VALVES

A. Manufacturers:

1. Apollo.
2. Milwaukee.
3. Nibco.

B. Up To and including 2 Inches: MSS SP-80, bronze body and cap, bronze swing disc with rubber seat, solder ends.

C. 2 1/2 Inches and Larger: MSS SP-71, iron body, bronze swing disc, renewable disc seal and seat.

D. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 – Low Lead & Lead Free Brass.

2.4 CIRCUIT BALANCING VALVES

A. Manufacturers:

1. Bell & Gossett.
2. Dunham Bush.
3. Armstrong.
4. Illinois.
5. HCI.

B. Orifice principle by-pass circuits with direct reading gage, soldered or flanged piping connections for 125 psig working pressure, with shut off valves, and drain and vent connections.

C. Direct reading with insert Pitot tube, threaded coupling, for 150 psig working pressure, maximum 240 degrees F, 5 percent accuracy.

D. 3 Inches and Smaller: Calibrated, ball type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

E. Provide manufacturer furnished molded insulated valve covers.

F. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 – Low Lead & Lead Free Brass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system is ready for valve installation.

3.2 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

D. Install valves with clearance for installation of insulation and allowing access.

E. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.

F. Refer to Section 22 05 29 for pipe hangers.

G. Refer to Section 22 07 00 for insulation requirements for valves.

H. Refer to Section 22 05 03 for piping materials applying to various system types.

I. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.3 VALVE APPLICATIONS

A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves for throttling, bypass, or manual flow control services.

D. Install spring loaded check valves on discharge of water pumps.

E. Install ball valves and gate valves in domestic water systems for shut-off service.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to plumbing work.
9. Firestopping accessories.
10. Equipment bases and supports.

B. Related Sections:

1. Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
2. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
3. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
4. Section 07 90 00 - Joint Protection: Product requirements for sealant materials for placement by this section.
5. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this section.
6. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
7. Section 22 11 00 - Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
8. Section 22 13 00 - Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Firestopping Materials: ASTM E119, ASTM E814, UL 263, and UL 1479 to achieve fire ratings of adjacent construction in accordance with FM, UL, and Design Numbers.

C. Surface Burning: ASTM E84 and UL 723 with maximum flame spread / smoke developed rating of 25/450.

D. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM and UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

G. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.13 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Carpenter & Paterson Inc.
2. Creative Systems Inc.
3. Flex-Weld, Inc.
4. Glope Pipe Hanger Products Inc.
5. Michigan Hanger Co.
6. Superior Valve Co.

B. Plumbing Piping:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
7. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Manufacturers:

1. Bolt Products, Inc.
2. Fastenal Fasteners.
3. Atwood Industries.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sealant: Acrylic refer to Section 07 90 00.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Galvanized 12 gage thick steel with holes 1-1/2 inches on center.

2.8 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer’s full range of colors.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Sheet metal.
2. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.

F. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide sheet lead packing between hanger or support and piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 21 05 48.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor drains watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray, bus, cable bus, conduit, wireway, trough, and penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

E. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 FIELD QUALITY CONTROL

A. Section 01 14 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

A. Pipe Hanger Spacing

Pipe Material	Maximum Hanger Spacing Feet	Hanger Rod Diameter Inches
Cast Iron (All sizes)	5	5/8
Cast Iron (All sizes) with 10’ length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
PVC (All sizes)	4	3/8
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Pipe markers.
4. Labels.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Substitutions: Not Permitted.

B. Product Description: Laminated three-layer plastic with engraved (see drawings for color) letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Not Permitted.

2. Laminated three-layer plastic with engraved letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter. See drawings for color.

B. Metal Tags:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Not Permitted.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

2.3 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Not Permitted.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Not Permitted.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.4 LABELS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.

3. Seton Identification Products.
4. Substitutions: Not Permitted.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 90 00.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow and direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Identification:

1. See drawings for details.

END OF SECTION 220553

SECTION 220590 - TESTING OF PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Waste and Vent Piping.
2. Domestic Water Piping.

1.2 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

N. ARI

O. ASME

P. NFPA

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. Before final acceptance of all piping system, all systems must be tested in accordance with the schedule and prove to be free of leaks.

1. Perform tests under observation of Architect/Engineer.
2. Underground systems shall be tested prior to backfilling.
3. Remove, replace or satisfactorily repair defective work revealed by tests.
4. Make piping repairs with new materials; caulking of screwed joints or pin holes is not permitted.
5. Furnish all test equipment and materials for testing.
6. Owner to furnish water for testing and flushing.

3.2 TESTING MATERIAL

A. Testing Medium:

1. Hydrostatic Testing Medium: Clean Water.
2. Pneumatic Testing Medium: Clean compressed air.

B. Pressure Testing Gauges: ANSI B40.1, Grade AA; minimum 6 inch diameter dial with scale divisions equal or less than maximum allowable pressure drop.

3.3 TESTING SYSTEMS

A. Waste and Vent System Piping:

1. Test with water or air before fixtures are set.
2. After plumbing fixtures have been set and traps filled with water, subject entire waste and vent systems to final test with smoke or peppermint.
3. Water Test:

a. Apply to drainage and vent system in sections or in entirety dependent on size of system.
b. When entire system is tested, tightly close all openings in pipes except highest opening and fill system with water to overflow point.
c. When system is tested in sections, tightly plug each opening except highest opening, fill each section with water and test each section with minimum 10 foot head of water; test each preceding section until entire system has been tested with minimum 10 foot head of water, except uppermost 10 feet of system.
d. Keep water in system or in portion under test, for minimum 30 minutes before inspection.
e. System must be tight at all joints.

4. Air Test:

a. When tests are made with air, apply minimum 5 psi with force pump and maintain 1 hour with no leakage apparent.
b. Use mercury-column in making test.

B. Domestic Water System:

1. When rough-in is complete and before fixtures are set, test entire hot and cold water piping systems as scheduled and prove tight.
2. Where portion of water piping system is concealed before completion, test that portion separately as specified for entire system.

C. Hydrostatic and Pneumatic Testing Requirements:

1. Hydrostatic and pneumatic tests apply to piping indicated as scheduled in Paragraph D.
2. Pressure to be raised gradually to given value; then block off tight at source.
3. Allowable Pressure Drop: Maximum amount scheduled during corresponding minimum time interval.

   a. Visually examine all joints during test.

4. Upon successful completion and test approval, relieve piping of pressure, drain, put into normal operation except for potable water to be sterilized before placing in service.

D. Hydrostatic and Pneumatic Testing Schedule:

	Service	Normal Work Pressure psig	Hydrostatic Test Pressure psig	Pneumatic Test Pressure psig	Maximum Allowable Pressure Drop psig	Minimum Test Time Hours
1.	Domestic Water :					
	Potable Water	To 125	175	---	2	2

3.4 CLEANING AND ADJUSTING

A. Cleaning: Thoroughly clean all parts of the piping installation at completion of work.

1. Remove grease, metal cutting and sludge form all equipment, pipes, valves all fittings.
2. Repair all stoppages, discoloration or other damage to finish, furnishings or parts of building that are due to Contractor’s failure to properly clean piping system.

B. Adjusting:

1. Adjust flush valves and other parts of work for quiet operation.
2. Adjust control devices for proper operation.
3. Demonstrate to Architect/Engineer satisfactory operation following adjustment.
4. Readjust or replace all items not functioning properly.

END OF SECTION 220590

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

B. Related Sections:

1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
2. Section 09 90 00 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
4. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
5. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
9. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
10. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
11. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
12. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
13. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
14. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
15. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
16. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
17. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
18. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
19. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.

C. Manufacturers for Polyisocyanurate Foam Insulation Products:

1. Dow Chemical Company.

D. Manufacturers for Extruded Polystyrene Insulation Products:

1. Dow Chemical Company.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.

2.3 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

B. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1784, One piece white molded type fitting covers, sheet material on all pipe fittings and valves.
2. Insulated piping systems concealed above ceilings or in mechanical rooms to have PVC plastic pipe jacketing at fittings.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

C. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

D. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 1.5 pound per cubic foot.

B. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 220 degrees F.

2.6 EQUIPMENT INSULATION JACKETS

A. PVC Plastic Equipment Jacket:

1. Product Description: ASTM D1784, sheet material, off-white color.
2. Minimum Service Temperature: -40degrees F.
3. Maximum Service Temperature: 150 degrees F.
4. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
5. Thickness: 20 mil.
6. Connections: Brush on welding adhesive.

2.7 EQUIPMENT INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify piping and equipment has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

E. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

F. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.

    a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

G. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

H. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer’s recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

I. High Temperature Pipe Insulation:

1. Install in multiple layers to meet thickness scheduled.
2. Attach each layer with bands. Secure first layer with bands before installing next layer.
3. Stagger joints between layers.
4. Finish with canvas jacket sized for finish painting.

3.3 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

D. Equipment Containing Fluids Below Ambient Temperature:

1. Insulate entire equipment surfaces.
2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees F or Less:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment Containing Fluids Over 140 degrees F:

1. Insulate flanges and unions with removable sections and jackets.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers

H. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

I. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

J. Prepare equipment insulation for finish painting. Refer to Section 09 90 00.

3.4 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

Piping System	Insulation Type	Pipe Size	Insulation Thickness Inches
Domestic Hot Water Supply and Recirculation	P-1	All sizes	1.0
Domestic Cold Water	P-1	2" and smaller	1.0
		2-1/2" and larger	1.0

B. Drainage Services Piping Insulation Schedule:

Piping System	Insulation Type	Pipe Size	Insulation Thickness Inches
Sanitary Sewer Piping – cast iron, PVC or copper piping receiving chilled water, condensate, water below ambient temperatures (insulate all horizontal suspended piping and all vertical piping)	P-1	All sizes	1.0
Sanitary Sewer Piping – PVC pipe (insulate all suspended piping and all vertical piping for sound deadening purposes except PVC routed in masonry walls or chases)	P-1	All sizes	1.0
Sanitary Sewer Piping – copper pipe (insulate all suspended piping and all vertical piping_	P-1	All sizes	1.0

C. Equipment Insulation Schedule:

Equipment	Insulation Type	Insulation Thickness Inches
Domestic Hot Water Storage Tanks	E-1	3.0

END OF SECTION 220700

SECTION 221100 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Thermometer supports.
5. Test plugs.
6. Relief valves.
7. Strainers.
8. Hose valves.
9. Water hammer arrestors.
10. Thermostatic mixing valves.
11. Diaphragm-type compression tanks.
12. System lubricated circulators.
13. Backflow preventers.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
2. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
3. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Product requirements for motors for placement by this section.
4. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
5. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
6. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
7. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
8. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
9. Refer to civil drawings for additional information - Soils for Earthwork: Soils for backfill in trenches.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.
2. NSF/ANSI Standard 61 – Low Lead & Lead Free Brass.
3. NSF/ANSI Standard 61, Annex F – Low Lead & Lead Free Brass.
4. NSF/ANSI Standard 61, Annex G – Low Lead & Lead Free Brass.
5. NSF/ANSI Standard 372 – Low Lead & Lead Free Brass.

B. American Society of Mechanical Engineers:

1. ASME B31.9 - Building Services Piping.
2. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

3. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. American Society of Sanitary Engineering:

1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
6. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
7. ASSE 5015 - Performance Requirements for Testing Double Check Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (RPDF).

D. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

E. American Water Works Association:

1. AWWA C651 - Disinfecting Water Mains.
2. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
3. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
4. AWWA C702 - Cold-Water Meters - Compound Type.
5. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
6. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

F. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. Plumbing and Drainage Institute:

1. PDI WH201 - Water Hammer Arrester Standard.

H. Underwriters Laboratories Inc.:

1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
2. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Shop Drawings: Provide 1/4" scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two loose keys for outside hose bibs.

1.12 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. Ashcroft.
2. Marsh Instrument Co.
3. Marshalltown Instruments, Inc.
4. Taylor.
5. Substitutions: Not Permitted.

B. Gage: ASME B40.1, UL 393 and UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Brass.
3. Dial Size: 4 inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: Both psi and kPa.

2.2 PRESSURE GAGE TAPS

A. Manufacturers:

1. Peterson Equipment Co.
2. Sisco.
3. Trerice.
4. Substitutions: Not Permitted.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

C. Ball Valve: Brass, 1/8 inch 1/4 inch NPT for 250 psi.

D. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

E. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Ashcroft.
2. Taylor.
3. Weiss Instruments, Inc.
4. Substitutions: Not Permitted.

B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 7 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch long.
4. Accuracy: ASTM E77 2 percent.
5. Calibration: Both degrees F and degrees C.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Furnish materials in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

2.6 RELIEF VALVES

A. Furnish materials in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

B. Pressure Relief:

1. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 60 psi, UL listed for fuel oil, capacities ASME certified and labeled.

C. Temperature and Pressure Relief:

1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.7 STRAINERS

A. Manufacturers:

1. Apollo.
2. Milwaukee.
3. Nibco.

B. 2 1/2 Inches and Smaller: Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2 1/2 Inches and Larger: Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 - Low Lead & Lead Free Brass.

2.8 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Sioux Chief
2. Precision Plumbing Products.
3. Watts.

B. ANSI A112.26.1M; sized in accordance with PDI WH-201, precharged, permanently sealed, suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

C. NSF/ANSI Standard 61, NSF 61 Annex F, NSF 61 Annex G & NSF 372 – Low Lead & Lead Free Brass.

2.9 HOSE VALVE (HV-1)

A. Manufacturers:

1. Woodford, Model B26.
2. Zurn.
3. J.R. Smith.

B. Freezeless hose valve, chrome finish, hose thread spout, integral backflow protector, and metal handle.

2.10 THERMOSTATIC MIXING VALVES

A. Thermostatic Mixing Valves (TMV-1)

1. Manufacturers:

B. Manufacturers:

1. Leonard, Model TM-2020B-LF-RF-DT-IT-TC.
2. Bradley.
3. Powers.

C. ASSE 1075; High-low manifold thermostatic mixing valve. Rough bronze finish, wall support, unions angle strainer, check stop on inlets, outlet ball valve, locking temperature regulator, built-in cold water bypass integral temperature adjustment.

D. Capacity: Minimum flow 1 gpm, maximum flow 129 gpm at 15 psi loss, 2" inlets and 2" outlet.

E. Accessories:

1. Strainer on inlets.
2. Volume control shut-off valve on outlet.
3. Dial thermometer on outlet.
4. Combination stop checks on inlets.
5. Dial thermometer on inlets.
6. Test connection.

F. NSF/ANSI Standard 61, NSF 61, Annex F, NSF 61 Annex G and NSF 372 - Low Lead and Lead Free Brass.

2.11 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Domestic Water Expansion Tank (DWET)

1. Manufacturers:

a. Amtrol.
b. Wessels.

2. Construction: Welded steel, tested and stamped in accordance with Section 8D of ASME Code; rated for working pressure of 150 psig, with heavy duty butyl bladder (FDA approved).
3. Accessories: Pressure gage and air-charging fitting; precharged.
4. Size: Refer to drawings.

2.12 SYSTEM LUBRICATED CIRCULATORS (DWP)

A. Manufacturers:

1. Bell & Gossett.
2. Owner approved equal.

B. Pumps shall be of the horizontal system lubricated type. Pump shall have ceramic shaft supported by carbon bearings. Bearings are to be lubricated by the circulating fluid. Pump body shall be lead-free bronze. Motor starter to be isolated from circulating fluid through use of stainless steel can. Rotor to be sheathed in stainless steel. Motors shall be non-overloading at any point on the pump curve. Motor to have built-in impedance protection.

C. Size: Refer to drawings.

2.13 REDUCED PRESSURE BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers

1. Manufacturers:

a. Watts Regulator Series 994-NRS.
b. Febco Valves.
c. Zurn-Wilkins.
d. Conbraco.

2. ANSI/ASSE 1013; The assembly shall consist of a pressure differential relief valve located in zone between two positive seating check valves. The main valve body shall be manufactured from 300 Series stainless steel for corrosion resistance. The check valves shall be of thermoplastic construction with stainless steel hinge pins, cam arm, and cam bearing. The check valve shall utilize a single torsion spring design to minimize pressure drop through the assembly. The check valves shall be modular and shall seal to the main valve body by the use of an O-ring. There shall be no brass or bronze parts used within the check assembly or relief valve. All internal parts shall be accessible through a single cover on the valve assembly securely held in place by a two-bolt grooved coupling. The differential relief valve shall be of stainless steel construction and shall utilize a rolling diaphragm and so sliding seals. The relief valves shall be bottom mounted and supplied with a steel reinforced sensing hose. The assembly shall include two resilient seated shutoff valves (non-rising) and four ball type test cocks.
3. NSF/ANSI Standard 61, NSF 61, Annex F, NSF 61 Annex G and NSF 372 - Low Lead and Lead Free Brass.

B. Reduced Pressure Backflow Preventers (BFP-2) - Boiler Make-Up:

1. Manufacturers:

a. Watts Regulator Series 909-QT.
b. Febco Valves.
c. Zurn-Wilkins.
d. Conbraco.

2. ANSI/ASSE 1013; Bronze body with bronze internal parts and stainless steel springs, two independently operating, spring loaded check valves, diaphragm type differential pressure relief valve located between check valves, third check valve that opens under back pressure in case of diaphragm failure, non-threaded vent outlet, assembled with two ball valves and four test cocks.
3. NSF/ANSI Standard 61, NSF 61, Annex F, NSF 61 Annex G and NSF 372 - Low Lead and Lead Free Brass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - THERMOMETERS AND GAGES

A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping.

C. Install pressure gages with pulsation dampers. Provide ball valve to isolate each gage.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

H. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Provide flow controls in water circulating systems as indicated on Drawings.

B. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

C. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping.

E. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

F. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.5 INSTALLATION - PUMPS

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Provide line sized shut-off valve on pump suction, and line sized soft seat check valve, and shut-off valve on pump discharge. Refer to Section 23 21 16.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

D. Lubricate pumps before start-up.

E. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test domestic water piping system in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

E. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION 221100

SECTION 221200 - FACILITY POTABLE WATER STORAGE TANKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes potable water storage tanks.

B. Related Sections:

1. Section 22 07 00 - Plumbing Insulation: Field applied insulation for water storage tanks.
2. Section 22 11 00 - Facility Water Distribution: Supply connections to water storage tanks.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate dimensions of tanks, materials of construction, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Shop Drawings: Provide 1/4” scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 QUALITY ASSURANCE

A. Conform to ASME Section VIII for construction of potable water storage tanks. Provide tanks registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and Local Jurisdiction amendments to Plumbing Code.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish three year manufacturer warranty for potable water storage tanks.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers:

1. Lochinvar.
2. Owner approved equal.

B. Tank:

1. Welded steel, ASME labeled for working pressure of 125 psig steel support saddles, tappings for accessories, threaded connections of stainless steel, access manhole.
2. Exterior of tanks shall be thoroughly cleaned and painted.
3. Tank shall have a five year limited warranty as outlined in the written warranty.

C. Lining:

1. Interior of tanks shall be glass-lined with an alkaline borosilicate composition which has been fused to the steel base by firing at a temperature of 1600 degrees F.
2. All internal surfaces exposed to water are glass-lined per ASME HLW code procedures using an NSF approved glass lining compound with nickelous oxide.
3. Tanks shall be insulated to meet current ASHRAE/IES 90.1-1992 efficiency requirements.
4. Cathodic protection shall be provided.

D. Openings: Up to 3 inches, copper-silicone threaded.

E. Accessories: Tank drain, water inlet and outlet, thermometer range of 40 to 200 degrees F, ASME pressure relief valve suitable for maximum working pressure.

F. Insulation: Refer to Section 22 07 00.

G. Size: Refer to drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and Local Jurisdiction amendments to Plumbing Code.

B. Provide support, independent of building structural framing members.

C. Clean and flush after installation. Seal until pipe connections are made.

D. Install the following piping accessories on domestic water piping connections. Refer to Section 22 11 00.

1. On inlet: Thermometer and shut-off valve.
2. On outlet: Thermometer and shut-off valve.

E. Install relief valve piping to nearest floor drain.

END OF SECTION 221200

SECTION 221300 - FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.
2. Cleanouts.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
3. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Product requirements for motors for placement by this section.
4. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
5. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
6. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
7. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
8. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
9. Refer to civil drawings for additional information - Soils for Earthwork: Soils for backfill in trenches.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.21.1 - Floor Drains.
2. ASME B31.9 - Building Services Piping.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Shop Drawings: Provide 1/4” scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of equipment and clean-outs.

C. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, Current Edition and local jurisdiction amendments to Plumbing Code.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with sewage ejector service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

1.12 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Floor Drain (FD-1):

1. Manufacturers:

a. Wade, Model 1340TD.
b. Zurn.
c. J.R. Smith.

2. ANSI A112.21.1; duco cast iron body with flashing collar and ductile iron grate, and sediment bucket.

2.2 CLEANOUTS

A. Floor Cleanout (FCO):

1. Manufacturers:

a. Wade, Model 6000Z.
b. Zurn.
c. J.R. Smith.

2. Interior Finished Floor Areas (FCO): Lacquered cast iron, two piece body with double drainage flange, and heavy duty 6”x6” square adjustable stainless steel scoriated cover assembly with stainless steel vandal proof screws and PVC gasket plug.

B. Wall Cleanouts (WCO):

1. Manufacturers:

a. Wade, Model 8560.
b. Zurn.
c. J.R. Smith.

2. Interior Finished Wall Areas: Line type with lacquered cast iron body and round brass gasketed plug and round stainless steel access cover secured with machine screw.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

B. Prepare piping connections to equipment with flanges or unions.

C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Install floor cleanouts at elevation to accommodate finished floor or grade.

D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, interior and exterior hose bibs.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION 221300

SECTION 223400 - FUEL FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial gas-fired water heaters.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Product requirements for pump motors for placement by this section.
3. Section 22 07 00 - Plumbing Insulation: Field applied insulation for domestic water heaters.
4. Section: 22 11 00 - Facility Water Distribution: Supply connections to domestic water heaters.
5. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for gas piping connections specified by this section.
6. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.10.1 - Gas Water Heaters Vol. I Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
2. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME PTC 25 - Pressure Relief Devices.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Fire Protection Association:

1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
2. NFPA 54 - National Fuel Gas Code.
3. NFPA 58 - Liquefied Petroleum Gas Code.

E. United States Department of Energy:

1. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Product Data:

1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
2. Pumps: Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Shop Drawings: Provide 1/4” scale drawings indicating equipment, control valves, shut-off valves, pipe routing, pipe elevations, etc. prior to fabrication.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.5 QUALITY ASSURANCE

A. Conform to ASME for construction of water heaters. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Perform Work in accordance with Illinois Department of Public Health Plumbing Code, current edition.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Products storage and handling requirements.

B. Accept water heaters on site in original labeled cartons. Inspect for damage.

C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

1.12 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2008)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2009)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 COMMERCIAL GAS FIRED WATER HEATERS

A. Acceptable Manufacturers:

1. Lochinvar.
2. Owner approved equal.

B. General:

1. The water heater shall bear the ASME "HLW" stamp and shall be National Board listed for inputs in excess of 200,000 Btu/Hr. There shall be no banding material, bolts, gaskets or "O" rings in the header configuration. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a five (5) year limited warranty.

C. Water Heater:

1. The water heater shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.10.3 test standard for the US and Canada The water heater shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The water heater shall be AHRI certified to 96% thermal efficiency. The water heater shall be certified for indoor installation.
2. The water heater shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The water heater shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating water heater firing rates for maximum efficiency. The water heater shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column.
3. The water heater shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for water heater set-up, water heater status, and water heater diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The water heater shall be equipped with; a high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, inlet water temperature sensor, a UL 353 certified flue temperature sensor, low water flow protection and built-in freeze protection. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
4. The water heater shall feature the “Smart System” control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys, password security, pump delay with freeze protection, pump exercise, and USB PC port connection. The water heater shall feature night setback for the domestic hot water tank and shall be capable of controlling a building recirculation pump while utilizing the night setback schedule for the building recirculation pump. The water heater shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint and enable/disable of the water heater, and a 0-10VDC output of water heater modulation rate. The water heater shall have a built-in cascading sequencer with modulation logic options of “lead lag” or “efficiency optimized”. Both modulation logic options should be capable of rotation while maintaining modulation of up to eight water heaters without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.
5. The water heater shall be equipped with two terminal strips for electrical connection. A low voltage connection board with data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Tank Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent control of the Domestic Hot Water Pump and Building Re-circulation Pump.

D. Water Heater Vent and Combustion Air:

1. Direct Vent Sidewall system with a vertical roof top termination of both the vent and combustion air. The flue shall be PVC or CPVC sealed vent material terminating at the sidewall with the manufacturers specified vent termination. A separate pipe shall supply combustion air directly to the water heater from the outside. The air inlet pipe may be PVC sealed pipe. The air inlet must terminate on the same sidewall with the manufacturer's specified air inlet cap. The contractor shall verify flue and combustion air sizes and arrangements with the boiler manufacturer.
2. The water heater shall have an independent laboratory rating for Oxides of Nitrogen (NOx) of 20 ppm or less, corrected to 3% O2.

E. Capacity: Refer to drawings.

F. Location: Refer to drawings.

G. Circulating Pump:

1. Shall be constructed of all bronze and operate on a 120 volt, 60 Hz, 1 phase power supply (unless otherwise specified). The pump shall be factory wired to run with intermittent pump operation

H. Flow Switch:

1. Shall be of a paddle type design and shall be wired to the internal boiler control safety circuitry so to not allow the boiler to operate when there is not sufficient flow.

I. Pressure Relief Valve:

1. Shall be ASME Certified.

J. Temperature and Pressure Gauge:

1. Shall be capable of reading temperature in both degrees Fahrenheit and degrees Celsius. The Pressure units shall be read in pounds per square inch (psi).

K. Optional Equipment:

1. Low water cut-off switch.
2. Condensate neutralization kit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install water heater on concrete housekeeping pad, minimum 4 inches high and 6 inches larger than water heater base on each side. Refer to Section 03 30 00.

C. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.

D. Follow manufacturer's recommended piping diagram for the appropriate number of heaters and storage tanks.

E. Install discharge piping from relief valves and drain valves to nearest floor drain.

F. Install water heater trim and accessories furnished loose for field mounting.

G. Install electrical devices furnished loose for field mounting.

H. Install Work in accordance with Illinois Department of Public Health Plumbing Code, current edition.

END OF SECTION 223400

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors for application on equipment provided under other sections.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 25 00 - Product Requirements: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

1.6 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT:

A. Motors 3/4 hp and Larger: Three-phase motor as specified below.

B. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer’s standard.

C. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

1. Voltage: As indicated on Drawings.
2. Service Factor: 1.15.
3. Enclosure: Meet conditions of installation unless specific enclosure.
4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
5. Insulation System: NEMA Class F.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
9. Sound Power Levels: Conform to NEMA MG 1.

D. Single Phase Motors:

1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
2. Voltage: 115/230 volts, single phase, 60 Hz.

E. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 THREE PHASE MOTORS FURNISHED LOOSE

A. Product Description: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds indicated.

B. Voltage: 230/460 volts, three phase, 60 Hz.

C. Service Factor: 1.15.

D. Enclosure: Meet conditions of installation unless specific enclosure is specified or indicated.

E. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

F. Insulation System: NEMA Class F.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: Conform to NEMA MG 1.

K. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.3 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

B. Contractors' tests and startups shall be scheduled and documented in accordance with the project.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned motors.

B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

B. Install engraved plastic nameplates.

C. Ground and bond motors.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible pipe connectors.
2. Expansion joints.
3. Expansion compensators.
4. Pipe alignment guides.
5. Swivel joints.
6. Pipe anchors.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature: 50 degrees F.
2. Steam Heating System Temperature: 240 degrees F.
3. Safety Factor: 30 percent.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints.

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 25 00 - Product Requirements: Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for leak free performance of packed expansion joints.

1.10 EXTRA MATERIALS

A. Section 01 77 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply two 12 ounce containers of packing lubricant and cartridge style grease gun.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS:

A. Steel Piping:

1. Inner Hose: Carbon Steel.
2. Exterior Sleeve: Braided stainless steel.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

B. Copper Piping:

1. Inner Hose: Bronze.
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

2.2 EXPANSION JOINTS:

A. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Application: Steel piping 3 inch and smaller.

2.3 ACCESSORIES:

A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

B. Swivel Joints: Fabricated steel and Cast steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Work in accordance with ASME B31.1.

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Refer to Section 23 05 48. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

E. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 22 05 29 for pipe hanger installation requirements.

F. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

G. Provide expansion loops where required or as indicated on Drawings.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 230516

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.

B. Related Sections:

1. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 or UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

B. Surface Burning: ASTM E84 or UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 25 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 25 00 - Product Requirements Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Section 01 77 00 - Execution and Closeout Requirements Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pipe hangers and supports.

1.13 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Unistrut.
2. Grinnell.
3. B-Line.

B. Hydronic Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch malleable iron or carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis, with roll.
4. Hangers for Hot Pipe Sizes 2 to 4 inches Carbon steel, adjustable, clevis, with roll.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 EQUIPMENT CURBS

A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, 1-1/2 inch thick insulation, factory installed wood nailer. Finish height to be 18" above high point of finished roof.

2.6 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel.

2.7 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel minimum with holes 1-1/2 inches on center.

2.9 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

2.10 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing or damming materials to arrest liquid material leakage.

D. Obtain permission from Architect before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Architect and Structural Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

C. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.

D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place intumescent coating in sufficient coats to achieve rating required.

F. Remove dam material after firestopping material has cured.

G. Fire Rated Surface:

1. Seal opening at floor, wall, partition, and ceiling as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

H. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, and ceiling roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 FIELD QUALITY CONTROL

A. Section 01 77 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

Pipe Size Inches	Copper Tubing Maximum Hanger Spacing Feet	Steel Pipe Maximum Hanger Spacing Feet	Copper Tubing Hanger Rod Diameter Inches	Steel Pipe Hanger Rod Diameter Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8

B. Plastic and Ductile Iron Pipe Hanger Spacing:

Pipe Material	Maximum Hanger Spacing Feet	Hanger Rod Diameter Inches
ABS (All sizes)	4	3/8
FRP (All Sizes)	4	3/8
PVC (All Sizes)	4	3/8

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vibration isolators.
2. Duct silencers.

B. Related Sections:

1. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product requirements for anchors and piping expansion compensation.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:

1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

C. Air-Conditioning and Refrigeration Institute:

1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

D. American Society of Heating, Refrigerating and:

1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
2. ASHRAE Handbook - HVAC Applications.

E. ASTM International:

1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.

F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

G. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of hangers including attachment points.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA 300, ANSI S1.13 standards and recommendations of ASHRAE 68.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for inertia bases.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers:

1. Mason Industries.
2. Amber Booth.
3. Vibration Eliminator.

B. Open Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

C. Restrained Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Furnish mounting frame and limit stops.

D. Closed Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

E. Restrained Closed Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

F. Spring Hanger:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, rubber hanger with threaded insert.

4. Misalignment: Capable of 20 degree hanger rod misalignment.

G. Neoprene Pad Isolators:

1. Rubber or neoprene-waffle pads.

a. 30 durometer.
b. Minimum 1/2 inch thick.
c. Maximum loading 40 psi.
d. Height of ribs: not to exceed 0.7 times width.

2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

H. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 EXISTING WORK

A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.

B. Extend existing piping and ductwork installations using materials and methods compatible with existing electrical installations.

3.3 INSTALLATION

A. Lag ductwork, where indicated by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork.

B. Install isolation for motor driven equipment.

C. Adjust equipment level.

D. Install spring hangers without binding.

E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

G. Support piping connections to isolated equipment resiliently as follows:

1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. 10 inch Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.4 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit report. Include static deflections.

B. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

C. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 EXTRA MATERIALS

A. Section 01 77 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Product Description: Laminated three-layer plastic with engraved (see drawings for color) letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.

2. Laminated three-layer plastic with engraved letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter. See drawings for color.

B. Metal Tags:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

2.3 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.4 LABELS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify rooftop units, variable air volume boxes, pumps, exhaust fans, heat exchangers, variable frequency drives, relief hoods, intake hood, expansion tank, air separators, gas shut-off valves, air cooled condensing units, etc. with plastic nameplates or stencil painting. Identify in-line pumps and other small devices with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow and direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

J. Tag automatic control, instruments, and relays. Key to control schematic.

3.3 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location directed by owner.

END OF SECTION 230553

SECTION 230590 - TESTING OF PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Heating Hot Water Piping.
2. Steam and Steam Condensate.
3. Natural Gas Piping.
4. Chemical Feed Piping.

B. Related Sections:

1. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for placement of hangers and supports specified by this section.
2. Section 23 22 13 - Steam and Condensate Heating Piping

1.2 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

N. ARI

O. ASME

P. NFPA

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. Before final acceptance of all piping system, all systems must be tested in accordance with the schedule and prove to be free of leaks.

1. Perform tests under observation of Architect/Engineer.
2. Underground systems shall be tested prior to backfilling.
3. Remove, replace or satisfactorily repair defective work revealed by tests.
4. Make piping repairs with new materials; caulking of screwed joints or pin holes is not permitted.
5. Furnish all test equipment and materials for testing.
6. Owner to furnish water for testing and flushing.

3.2 TESTING MATERIAL

A. Testing Medium:

1. Hydrostatic Testing Medium: Clean Water.
2. Pneumatic Testing Medium: Clean compressed air.

B. Pressure Testing Gauges: ANSI B40.1, Grade AA; minimum 6 inch diameter dial with scale divisions equal or less than maximum allowable pressure drop.

3.3 TESTING SYSTEMS

A. Hydrostatic and Pneumatic Testing Requirements:

1. Hydrostatic and pneumatic tests apply to piping indicated as scheduled in Paragraph B.
2. Pressure to be raised gradually to given value; then block off tight at source.
3. Allowable Pressure Drop: Maximum amount scheduled during corresponding minimum time interval.

a. Visually examine all joints during test.

4. Upon successful completion and test approval, relieve piping of pressure, drain, put into normal operation.

B. Hydrostatic and Pneumatic Testing Schedule:

Service	Normal Work Pressure psig	Hydrostatic Test Pressure psig	Pneumatic Test Pressure psig	Maximum Allowable Pressure Drop psig	Minimum Test Time Hours
1. Heating Systems:					
Heating Water	To 100	150	---	2	2
Steam and Steam Condensate	To 15	---	150	2	2

2.	Fuel:					
	Natural Gas	To 25	---	100	0	8
3.	Chemical Feed	To 290	---	300	0	4

3.4 CLEANING AND ADJUSTING

A. Cleaning: Thoroughly clean all parts of the piping installation at completion of work.

1. Remove grease, metal cutting and sludge from all equipment, pipes, valves all fittings.
2. Repair all stoppages, discoloration or other damage to finish, furnishings or parts of building that are due to Contractor's failure to properly clean piping system.

B. Adjusting:

1. Adjust flush valves and other parts of work for quiet operation.
2. Adjust control devices for proper operation.
3. Demonstrate to Architect/Engineer satisfactory operation following adjustment.
4. Readjust or replace all items not functioning properly.

END OF SECTION 230590

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Testing, adjusting, and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.

B. Related Sections:

1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Prior to commencing Work, submit proof of latest calibration date of each instrument.

C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms containing information indicated in Schedules.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty.

F. Submit draft copies of report for review prior to final acceptance of Project.

G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 ACCEPTABLE BALANCING CONTRACTORS

A. Independent Test and Balance.

B. Mechanical Test and Balance.

C. Superior Test and Balance.

D. Professional System Analysis.

E. Airdronic Test and Balance.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.

C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111, NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. Maintain one copy of each document on site.

C. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.7 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum five years documented experience certified by AABC or Certified by NEBB.

1.8 SEQUENCING

A. Section 01 10 00 - Summary: Work sequence.

B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Schedule and provide assistance in final adjustment and test of life safety and smoke evacuation system with Fire Authority.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.

15. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Verify recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

O. On fan powered VAV boxes, adjust airflow switches for proper operation.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

1. HVAC Pumps.
2. Boilers.
3. Exhaust Fans.
4. Packaged Rooftop Units.
5. Air Filters.

6. Air Inlets and Outlets.

B. Report Forms

1. Title Page:

a. Name of Testing, Adjusting, and Balancing Agency
b. Address of Testing, Adjusting, and Balancing Agency
c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
d. Project name
e. Project location
f. Project Architect
g. Project Engineer
h. Project Contractor
i. Project altitude
j. Report date

2. Summary Comments:

a. Design versus final performance
b. Notable characteristics of system
c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization
e. Nomenclature used throughout report
f. Test conditions

3. Instrument List:

a. Instrument
b. Manufacturer
c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:

a. Manufacturer
b. Model/Frame
c. HP/BHP and kW
d. Phase, voltage, amperage; nameplate, actual, no load
e. RPM
f. Service factor
g. Starter size, rating, heater elements
h. Sheave Make/Size/Bore

5. V-Belt Drive:

a. Identification/location
b. Required driven RPM
c. Driven sheave, diameter and RPM
d. Belt, size and quantity
e. Motor sheave diameter and RPM
f. Center to center distance, maximum, minimum, and actual

6. Pump Data:

    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP and kW
    g. Actual flow rate, pressure drop, BHP and kW
    h. Discharge pressure
    i. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures
    l. Shut off, total head pressure

7. Cooling Coil Data:

    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Entering air DB temperature, design and actual
    g. Entering air WB temperature, design and actual
    h. Leaving air DB temperature, design and actual
    i. Leaving air WB temperature, design and actual
    j. Water flow, design and actual
    k. Water pressure drop, design and actual
    l. Entering water temperature, design and actual
    m. Leaving water temperature, design and actual
    n. Saturated suction temperature, design and actual
    o. Air pressure drop, design and actual

8. Heating Coil Data:

    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Water flow, design and actual
    g. Water pressure drop, design and actual
    h. Entering water temperature, design and actual
    i. Leaving water temperature, design and actual
    j. Entering air temperature, design and actual
    k. Leaving air temperature, design and actual
    l. Air pressure drop, design and actual

9. Air Moving Equipment:

    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Arrangement/Class/Discharge
    f. Air flow, specified and actual
    g. Return air flow, specified and actual
    h. Outside air flow, specified and actual
    i. Total static pressure (total external), specified and actual
    j. Inlet pressure
    k. Discharge pressure
    l. Sheave Make/Size/Bore
    m. Number of Belts/Make/Size
    n. Fan RPM

10. Return Air/Outside Air Data:

    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature
    j. Required mixed air temperature
    k. Actual mixed air temperature
    l. Design outside/return air ratio
    m. Actual outside/return air ratio

11. Exhaust Fan Data:

    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore
    j. Number of Belts/Make/Size
    k. Fan RPM

12. Duct Traverse:

    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor

13. Air Distribution Test Sheet:

    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Area factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity
    i. Test (final) air flow
    j. Percent of design air flow

14. Combustion Test:

    a. Manufacturer
    b. Model number
    c. Serial number
    d. Firing rate
    e. Overfire draft
    f. Gas meter timing dial size
    g. Gas meter time per revolution
    h. Gas pressure at meter outlet
    i. Gas flow rate
    j. Heat input
    k. Burner manifold gas pressure
    l. Percent carbon monoxide (CO)
    m. Percent carbon dioxide (CO2)
    n. Percent oxygen (O2)
    o. Percent excess air
    p. Flue gas temperature at outlet
    q. Ambient temperature
    r. Net stack temperature
    s. Percent stack loss
    t. Percent combustion efficiency
    u. Heat output

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets and accessories.
2. HVAC ductwork insulation, jackets, and accessories.
3. HVAC equipment insulation.
4. Emergency generator exhaust.

1.2 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
4. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
5. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
6. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
7. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
8. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
9. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
10. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
11. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
12. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
13. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
14. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
15. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
16. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
17. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
18. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
19. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
2. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 25 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 25 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. TYPE P-1: Glass Fiber:

1. Manufacturers:

a. Knauf Insulation Earthwool 1000 F with Ecose Technology.
b. Owens Corning Fiberglass.
c. Certainteed Corp.
d. Mansville.

2. Insulation: ASTM C547; rigid molded, noncombustible.

a. 'K' Value: ASTM C335, 0.23 at 75 degrees F mean temperature.
b. Minimum Service Temperature: 0 degrees F.
c. Maximum Service Temperature: 1000 degrees F maximum temperature.
d. Maximum Moisture Absorption: 0.2 percent by volume.

3. Factory Applied: Vapor Barrier Jacket:

   a. ASJ+/SSL+: All service jacket with advanced closure system self-sealing lap. The all service jacket is composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed; conforming to ASTM C1136 Type I, II, III, IV & VIII; vapor retarder; with a self-sealing adhesive.

      1) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
      2) Secure with self-sealing longitudinal laps and butt strips.

4. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch center.
5. Vapor Barrier Lap Adhesive:

   a. Compatible with insulation.

6. Insulating Cement/Mastic:

   a. Manufacturers:

      1) Dabco.

   b. ASTM C195; hydraulic setting on mineral wool.

B. TYPE P-2: Cellular Glass:

1. Insulation shall be cellular glass insulation manufactured in accordance with ASTM C552, “Standard Specification for Cellular Glass Thermal Insulation”.

   a. The pipe insulation shall be fabricated according to the requirements of ASTM C1639 “Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation”.
   b. The pipe insulation may be fabricated in half, curved sidewall, segmented, or StrataFab® System, depending on the operating conditions. Fabrication adhesive for standard cellular glass insulation pipe insulation shall be Hydrocal® B-11 or PC® 136 adhesive. For systems operating above 205°C (401°F), StrataFab® System, or segmented insulation is required.

2. Bore Coating:

   a. Bore coating for carbon steel pipe shall be Hydrocal® B-11 gypsum cement, manufactured by U.S. Gypsum Corporation.

3. Insulation jacketing:

   a. Jacketing for indoor applications may be one of any non-cellulous multi-ply laminated fiberglass-reinforced polypropylene, PVC, or vinyl faced/metalized film backed jacket. Jacket must not contain known mold or mildew nutrients, and exhibit no mold growth when tested according to ASTM C1338 “Determining Fungi Resistance of Insulation Materials and Facings”.

4. Tape shall be 19 mm (0.75 in.) wide fiber reinforced tape such as Scotch #880 or equal.

C. TYPE P-3: EPDM Elastomeric Cellular Pipe Insulation:

1. Acceptable Manufacturers:

   a. Aeroflex/Aerocel.
   b. Armaflex.
   c. K-Flex/Echo

2. Insulation:

   a. Insulation material shall be an EPDM rubber, flexible, closed-cell elastomeric insulation in tubular form. The product will be tested for and meet or exceed the requirements defined in ASTM C534.
   b. EPDM elastomeric insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's.
   c. EPDM elastomeric insulation shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E84, for all products through 2" thickness. Product to be suitable for use from -297°F to 300°F continuous service temperature, per ASTM C411.
   d. EPDM elastomeric insulation shall have a maximum thermal conductivity of 0.245 Btu-in./h/ft^2-°F at a 75°F mean temperature when tested in accordance with ASTM C177 or ASTM C518.
   e. EPDM elastomeric insulation shall have a maximum water vapor transmission of 0.03 perm-inches when tested in accordance with ASTM E96, Procedure A, latest revision.
   f. Product must exhibit long-term UV resistance, when unfinished in outdoor installations, per ASTM G7 and ASTM G90.
   g. EPDM elastomeric insulation must not contribute to external stress corrosion cracking as when tested by ASTM C692.
   h. Longitudinal joints shall have factory applied lap tape.

3. Adhesives, Tapes, and Finishes:

   a. Adhesives shall be the insulation manufacturer's recommended contact adhesive: Aerocel Aeroseal or approved equal.
   b. Seaming tape to be 15-mil EPDM rubber with acrylic adhesive: Aerocel Protape or approved equal.
   c. Elbows, "P" traps, and Tees with mitered insulation fittings using tubular EPDM flexible elastomeric insulation sections, color matched to pipe insulation. **All exposed piping shall be off-white.**
   d. Accessories such as adhesives, mastics and cements shall not detract from any of the system ratings as specified above.

4. Insulated Pipe Saddles:

   a. Insulated pipe saddles will be high-density insulation with an inner lining of EPDM rubber insulating tape and an EPDM rubber exterior or jacket.
   b. Density of insulation is to be a minimum of 10 lbs./cu/ ft., with a compressive strength of 284 P.S.I. or greater, and a k-value of .312 or lower, usage temperature range of -297°F to 257°F, water absorption of 5% or less. Exterior jacket is to be 15-mil thick EPDM rubber.

D. TYPE P-4: Calcium Silicate:

1. Hydrous Calcium Silicate: ASTM C533; rigid molded block, asbestos free color coded throughout material thickness and maintained throughout temperature range.

   a. 'K' ('ksi') Value; 0.40 at 300°F.
   b. Maximum Service Temperature: 1200°F.
   c. Compressive Strength (block): Minimum of 200 psi to produce 5% compression based on 1 1/2" thickness.
   d. Non-combustible as determined by test following ASTM E 136.
   e. Securement: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge galvanized or stainless steel wire or 1/2" x .015" galvanized steel bands on 12" maximum centers for large areas.
   f. Provide embossed aluminum jacket over insulation, indoors and outdoors.

2.2 JACKETS

A. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color.

1. Minimum Service Temperature: -40 degrees F.
2. Maximum Service Temperature: 150 degrees F.
3. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
4. Maximum Flame Spread: ASTM E84; 25.
5. Maximum Smoke Developed: ASTM E84; 50.

B. Canvas Jacket: UL listed:

1. Fabric: ASTM C921, 6 oz./sq. yd., plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive
3. Compatible with insulation.

C. Redi-Klad: Redi-Klad Jacket: Venture Clad 5-ply weather and abuse resistant with self-seal lap, Living Building Challenge - Declare, Red List free. Puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb. (19.4 N) per ASTM D 624; thickness 14.5 mils (0.0145”); tensile strength 68.0 lb./inch width [306 N (31 kg)/25 mm].

1. Moisture Vapor Transmission: ASTM E 96-05; 0.0 perm inches.
2. Secure with self-sealing longitudinal laps and butt strips.

2.3 DUCTWORK INSULATION

A. TYPE D-1: ASTM C553, flexible, noncombustible blanket.

1. ‘K’ Value: ASTM C518, 0.29 at 75 degrees.
2. Maximum moisture absorption: 0.20 percent by volume.

B. TYPE D-2: ASTM C612, rigid, noncombustible fiberglass duct board.

1. ‘K’ Value: ASTM C518, 0.29 at 75 degrees.
2. Maximum moisture absorption: 0.20 percent by volume.
3. Density: 3 lb/cu ft.
4. Thickness: 2”.

C. TYPE D-3: ASTM C553, flexible, noncombustible fiberglass duct liner.

1. ‘K’ Value: ASTM C518, 0.29 at 75 degrees.
2. Density: 1.5 lb/cu ft.
3. Maximum velocity on coated air side: 4,000 ft/min.

D. TYPE D-4 (Johns-Manville: Series Spin-Glas): ASTM C612, type II, rigid board, non-combustible:

1. Density: 6.0 pcf
2. Thermal Conductivity: 0.22 Btu•in/(hr•ft^2•°F)
3. Flame spread greater than 25 and a smoke developed no greater than 50 when tested as in accordance with ASTM E 84, UL 723 or NFPA 255.
4. Vapor Retarder Jacketing: AP, a bleached kraft paper reinforced with a glass fiber yarn and bonded to an aluminum foil complying with ASTM C1136 type I or FSK, aluminum foil reinforced with a glass fiber yarn and laminated to fire-resistant kraft complying with ASTM C1136 type II.
5. Zeston 300 PVC Field Applied Jackets:

a. 40 mil stock thickness.

b. Joints secured and sealed with Perma-Weld Adhesive.

2.4 DUCTWORK INSULATION JACKETS

A. Vapor Retarder Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Secure with pressure sensitive tape.

B. Canvas Duct Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

C. Outdoor Duct Jacket: Ventureclad.

D. Membrane Duct Jacket: ASTM D4637; Type I, EPDM; non-reinforced, 0.045 inch thick, 48 inch wide roll; white color.

2.5 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Liner Fasteners: Galvanized steel, self-adhesive pad or welded with press-on head.

E. Lagging Adhesive: Fire resistive to ASTM E84.

F. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

G. Adhesives: Compatible with insulation.

H. Membrane Adhesives: As recommended by membrane manufacturer.

2.6 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C547 Type IV Grade A, ASTM C585, ASTM C411, and ASTM C795 Knauf Insulation Earthwool 1000°F with Ecose Technology glass fiber, molded, noncombustible.

1. ASTM C335: Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 1000 degrees F.
3. Density: 4.0 pound per cubic foot.
4. Component FHC 25/50 per ASTM E84.
5. Jacket: Ventureclad 5-ply weather and abuse resistant with self-sealing lap.

B. TYPE E-2: ASTM C1393, ASTM C795, ASTM C447, semi-rigid noncombustible.

1. ASTM C177: Thermal Conductivity: 0.25 at 75 degrees F mean temperature.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Density: 2.8 pound per cubic foot.
4. FHC 25/50 per ASTM E84.
5. Compromise Strength: Not less than 120 PSF at 10 at deformation per ASTM C165.
6. Vapor Retarder Jacket: ASTM C1136, ASJ Type I, II, III, and FSK Type II, IV.
7. Jacket: Ventureclad 5-ply weather and abuse resistant with self-sealing lap.

2.7 EQUIPMENT INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm-inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed and dry.

3.2 INSTALLATION - PIPING SYSTEMS

A. Install materials in accordance with manufacturer's instructions.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

D. For insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
3. PVC fitting covers may be used.
4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump body and expansion joints.

E. For insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with vapor barrier, factory applied or field applied.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
3. Finish with glass cloth and adhesive.
4. PVC fitting covers may be used.
5. For hot piping water do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. Insulated cold pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
3. PVC fitting covers may be used.
4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

G. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Provide heavy density insulating material suitable for the planned temperature range.

I. Finish insulation at supports, protrusions, and interruptions.

J. All fittings in fiberglass covered systems: Elbows, tees, valve bodies etc. shall be insulated with blanket insulation with equivalent thickness as the surrounding pipe and finished with PVC jackets.

K. Provide insulated valve and thermometer extensions as required for the specified pipe insulation thickness.

L. High density foam must be below each hanger and shall be able to support the weight of the piping system.

M. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

N. EPDM Cellular Elastomeric Insulation:

1. Piping, Valves, Fittings:

a. All piping, valves, fittings, duct, and equipment scheduled to be insulated shall have all insulation applied in strict accordance with manufacturer's installation instructions, and practices described in the National Commercial and Industrial Insulation Standards Manual. Manufacturer's installation guidelines and instruction will be used if conflicts exist.
b. Piping up to 10" inside diameter is to be insulated using preformed pipe insulation. Piping over 10" inside diameter may be insulated with preformed pipe insulation or sheet insulation, applied according to manufacturer's installation instruction and practices described in the National Commercial and Industrial Insulation Standards Manual.
c. Insulated pipe saddles are to be at all pipe hanger and clamp locations. Saddles are to be installed at the time that piping is being installed, so that insulation system can be installed in a continuous manner through the pipe support system.
d. No additional coating or finish is required for weathering resistance. Coatings or jacket may be required for aesthetic, damage resistance, or vapor barrier enhancement purposes.

e. At a minimum, thickness used will be in accordance with the thickness tables for piping insulation used in the latest version of ASHRAE 90.1. These thicknesses may or may not sufficient to control condensation. Thickness required to control condensation may be greater than the recommendations of ASHRAE E90.1.
f. All exposed pipe insulation shall be off-white.
g. All longitudinal and butt joints shall have lap tape applied.

3.3 INSTALLATION - CELLULAR GLASS INSULATION

A. In the temperature range of 83°C (181°F) to 204°C (400°F), the insulation may be applied in a single layer. Insulation should be fabricated in half sections or curved sidewall segments where possible.

B. The insulation shall be applied to piping with all joints dry and tightly fitted to eliminate voids. All ill-fitting or broken insulation shall be refitted or replaced.

C. Insulation may be taped or banded in place. Banding or tape shall be installed on equal spacing such that there are two bands or round of tape per section of insulation. Securement shall be a minimum of four inches (4”) from the end of any insulation section. Care shall be taken not to damage the insulation during banding. All damaged insulation shall be replaced before jacketing. Tape securement shall be applied to overlap a minimum of 50%.

D. Fittings shall be insulated in a manner similar to piping. Where the outer diameter of fitting insulation is larger than that of adjacent piping, a beveled or tapered transition section shall be provided.

E. Jacket:

1. As an alternate to metal jacket on indoor lines not subject to wash-down or moisture intrusion, a laminated jacket may be used as the insulation finish. The laminated jacket should be applied in accordance with manufacturer’s recommendations.

3.4 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

E. Duct and Plenum Liner:

1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

3.5 PIPE SYSTEMS INSULATION SCHEDULE

Piping Systems	Insulation Type	Pipe Size Inch	Thickness Inch
A. Heating Systems:			
Interior Heating Low Pressure Steam & Low Pressure Steam Condensate, Boiler Feed, Pumped Condensate	P-1**	Up to 1 1/2” 2” and Up	2 1/2” 3”
Low Pressure Steam & Steam Condensate, Boiler Feed, Pumped Condensate, Boiler Blowdown Piping in Boiler Room from Floor to 4’-0” Above the Floor	P-2	Up to 12”	2”
Make-Up Water	P-1	Up to 1 1/2” 2” and Up	1 1/2” 2”
Blowdown Piping at Separator	P-1*	Up to 6”	2 1/2”
Personnel Protection at Blowdown Separator to a Distance of 10’-0” Above the Floor	P-1*	All Sizes	2”
Hot Water Piping	P-1	Up to 1 1/2” 2” and Up	1 1/2” 2”
Emergency Generator	P-4	All Sizes	4”***

*Provide embossed aluminum jacket.
**Insulate all flanged steam valves 6” and larger.
***Provide embossed aluminum jacket indoors and outdoors.

3.6 DUCT SYSTEMS INSULATION SCHEDULE

	Ductwork	Insulation Type	Thickness Inch
A.	Supply and Return Ducts	D-2	1-1/2”
B.	Combustion Air and Outside Air Ductwork	D-2	2”
C.	Mixed Air Ductwork	D-2	1-1/2”
D.	HVAC Plenums	D-2	2”

3.7 EQUIPMENT INSULATION

	HVAC Equipment	Type	Thickness Inch
A.	Blowdown Separator	E-1*	2”
B.	Boiler Feed System	E-2	3”
C.	Heat Exchangers	E-2	3”

*Provide embossed aluminum jacket.

END OF SECTION 230700

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carbon dioxide sensors.
2. Control panel enclosures.
3. Humidistats.
4. Thermostats/sensors.
5. Control air dampers.
6. Electric damper actuators.
7. Control valves.
8. Electric valve actuators.
9. Outside air measuring and modulation device.
10. Direct digital control system components.
11. Differential pressure monitor.
12. Cable.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for thermometer sockets and gage taps for placement by this section. Installation requirements for piping products furnished in this section.
4. Section 23 33 00 - Air Duct Accessories: Product requirements for duct mounted thermometers. Installation requirements for dampers and other duct mounted products furnished in this section.
5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

C. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B32 - Standard Specification for Solder Metal.

4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
6. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. National Electrical Manufacturers Association:

1. NEMA DC 3 - Residential Controls - Electrical Wall Mounted Room Thermostats.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. National Fire Protection Association:

1. NFPA 72 - National Fire Alarm Code.
2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

H. Underwriters Laboratories, Inc.:

1. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.

C. Product Data: Submit description and engineering data for each control system component. Include sizing as required.

D. Manufacturer's Installation Instructions: Submit installation requirements for each control component.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.

C. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.5 QUALITY ASSURANCE

A. Provide pneumatic tubing located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with UL 1820.

B. Control Air Damper Performance: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept controls on site in original factory packaging Inspect for damage.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of control components in piping systems with work of Section 23 21 16.

C. Coordinate installation of control components in duct systems with work of Section 23 33 00.

1.9 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

B. Furnish service and maintenance of control system for one year from Date of Substantial Completion.

C. Furnish complete service of controls systems, including callbacks.

D. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

E. Perform work without removing units from service during building normal occupied hours.

F. Provide emergency call back service during working hours for this maintenance period.

G. Maintain an adequate stock of parts locally for replacement or emergency purposes. Ensure personnel availability to ensure fulfillment of this maintenance service without unreasonable loss of time.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each type of thermostat, humidistat or exposed sensor.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA 250, general purpose utility enclosures with enameled finished face panel.

C. Provide common keying for all panels.

2.2 CONTROL VALVES

A. Globe Pattern:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
3. Hydronic Systems:

    a. Rate for service pressure of 125 psig at 250 degrees F.
    b. Replaceable plugs and seats of stainless steel or brass.
    c. Size for 3 psig maximum pressure drop at design flow rate.
    d. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.

B. Electronic Operators:

1. Manufacturer: Belimo or owner approved equal.
2. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.
3. Select operator for full shut off at maximum pump differential pressure.

C. Reheat Valves:

1. Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
2. Rate for service pressure of 125 psig at 250 degrees F.
3. Size for 3 psig maximum pressure drop at design flow rate.
4. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.
5. Operators (Modulating): Self contained, linear motorized actuator with approximately 3/4 inch stroke, 60 second full travel: 24 v DC, 6 watt maximum input.

D. Radiation Valves:

1. Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
2. Rate for service pressure of 125 psig at 250 degrees F.
3. Size for 3 psig maximum pressure drop at design flow rate.
4. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.
5. Spring Return: Self contained, linear motorized actuator with approximately 3/4 inch stroke, 60 second full travel: 24 v DC, 6 watt maximum input.

2.3 DAMPERS

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, welded or riveted with corner reinforcement.

C. Blades: Galvanized steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.

D. Blade Seals: Synthetic elastomeric or Neoprene mechanically attached, field replaceable.

E. Jamb Seals: Spring stainless steel.

F. Shaft Bearings: Graphite impregnated nylon sleeve, with thrust washers at bearings or lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.

G. Linkage Bearings: Graphite impregnated nylon.

H. Leakage: Less than 2 percent based on approach velocity of 2000 ft/min and 4 inches w.g.

I. Maximum Pressure Differential: 6 inches w.g.

J. Temperature Limits: -40 to 200 degrees F.

2.4 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

B. Electric Operators:

1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch minimum position potentiometer and 24 V dc, 24 va transformer.
2. Manufacturer: Belimo or owner approved equal.

C. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide one damper operator for maximum 25 sq ft damper section.

2.5 INPUT/OUTPUT SENSORS

A. Temperature:

1. Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 70 degrees F, interchangeability less than plus or minus 0.2 percent, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.
2. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification sensor length 8 feet or 16 feet as required.
3. Insertion elements for liquids shall be with stainless steel socket with minimum insertion length of 2-1/2 inches.
4. Outside air sensors: Watertight inlet fitting, shielded from direct rays of sun.

B. Static Pressure Sensors:

1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensates with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0 - 5 vdc with power at 12 to 28 vdc.

C. Equipment Operation Sensors:

1. Status Inputs for Fans/Pumps: Differential pressure switch with adjustable range of 0 to 5 inches w.g. (0 to 1250 Pa).
2. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

D. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

2.6 THERMOSTATS/SENSORS

A. Room Temperature Thermostat/Sensors.

1. Room sensors shall be constructed for either surface or wallbox mounting.
2. Room sensors shall be flush mounted stainless steel plate with a 10k Type II thermistor sensor only, setpoint to be adjusted via BAS, no occupancy override.

B. Line Voltage Thermostats:

1. Integral manual On/Off/Auto selector switch, single or two pole as required.
2. Dead band: Maximum 2 degrees F.
3. Cover: Locking with concealed setpoint, without thermometer.
4. Rating: Motor load.

C. Outdoor Reset Thermostat:

1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
2. Scale range: -10 to 70 degrees F.

D. Immersion Thermostat:

1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.

E. Airstream Thermostats:

1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
2. Averaging service remote bulb element: 20 feet.

F. Electric Low Limit Duct Thermostat:

1. Snap acting, double pole, single throw snap action contacts rated for 16 amps at 120 vac, manual reset switch which trips if temperature sensed across any 18 inches of bulb length is equal to or below setpoint,
2. Bulb length: Minimum 20 feet.
3. Provide one thermostat for every 20 sq ft of coil surface.

G. Outside Air Sensors.

1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
3. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

H. Duct Mount Sensors.

1. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

I. Averaging Sensors.

1. For ductwork greater in any dimension the 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
3. Capillary supports at the sides of the duct shall be provided to support the sensing strip.

2.7 TRANSMITTERS

A. Differential Pressure Transmitters.

1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
2. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
4. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible. Low Differential Water Pressure Applications (0" - 20" w.c.).
5. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
6. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

    a. .01-20" w.c. input differential pressure range.
    b. 4-20 mA output.
    c. Maintain accuracy up to 20 to 1 ratio turndown.
    d. Reference Accuracy: +0.2% of full span.

B. Low Differential Air Pressure Applications (0" to 5" w.c.).

1. The differential pressure transmitter shall be of industry quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustment that are adjustable from the outside cover and meet the following performance specifications:

    a. (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
    b. 4-20 mA output.
    c. Maintain accuracy up to 20 to 1 ratio turndown.
    d. Reference Accuracy: +.02% of full span.

C. Temperature Transmitters:

1. One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 200 degree F span and plus or minus 1 percent for 50 degree span, with suitable temperature range, compensated bulb, averaging capillary, or rod.

2.8 STATUS AND SAFETY SWITCHES

A. General Requirements.

1. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the FMS when a failure or abnormal conditions occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

B. Current Sensing Switches.

1. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
2. Current sensing switches shall be used for run status for fans, over-current up to twice its trip point range.
3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

C. Air Filter Status Switches

1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120 VAC.
2. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
3. Provide appropriate scale range and differential adjustment for intended service.

D. Air Pressure Safety Switches

1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120 VAC.
2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

2.9 CABLE

A. Manufacturers:

1. Southwest Wire, 5950 Office Boulevard NE, Albuquerque, New Mexico 87109. Contact: Betty McMurrough. Phone: (800) 334·2150, Fax: (505) 345·3862.
2. Windy City Wire, 832 South Central Avenue, Chicago, Illinois 60644. Contact: Damn Marci. Phone: (800) 379-119, Fax: (773) 379·1243.

B. School District 205 Wiring Standard:

1. Cable shall be 18 AWG wire, plenum rated, shield.
2. Color Coding (verify final color coding with school district and school district's controls maintenance contractor prior to purchase):

a.	N2 Bus	B1ue
b.	Analog Input Cable	Yellow
c.	Analog Output Cable	Tan
d.	Binary Input Cable	Orange
e.	Binary Output Cable	Violet
f.	N1 Bus	Purple
g.	24 VAC Cable	Gray
h.	Spare	White
i.	Ethernet -CAT 5	Purple
j.	N2 E	Pink

3. All cable will be purchased from the school district's preferred vendors listed above.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify pneumatic tubing is clear of water, oil or other contaminants and compressed air supply has filter and dryer operating before installing control devices or actuators.

C. Verify air handling units and ductwork installation is complete and air filters are in place before installing sensors in air streams.

D. Verify location of thermostats and humidistats and other exposed control sensors with Drawings before installation.

E. Verify building systems to be controlled are ready to operate.

3.2 INSTALLATION

A. Install thermostats, humidistats, and space temperature sensors after locations are coordinated with other Work.

B. Install thermostats, humidistats, and space temperature sensors 48 inches above floor. Align with light switches.

C. Install freeze protection thermostats using flanges and element holders.

D. Install outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide separable sockets for liquids and flanges for air bulb elements. Refer to Section 23 21 16.

F. Install guards on thermostats in public areas, entrances, gymnasiums, etc. and as indicated on Drawings.

G. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face. Label with appropriate equipment or system designation.

H. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

I. Install conduit and electrical wiring in accordance with Section 26 05 03.

3.3 FIELD QUALITY CONTROL

A. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

B. Contractors' tests and startups shall be scheduled and documented in accordance with the project requirements.

3.4 DEMONSTRATION AND TRAINING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.

C. Demonstrate complete and operating system to Owner.

D. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 01 77 00 for general contractor closeout requirements. Refer to individual sections for specific contractor training requirements.

END OF SECTION 230900

SECTION 230923 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control equipment and software.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: Control system components.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI MC85.1 - Terminology for Automatic Control.

1.3 SYSTEM DESCRIPTION

A. Building automation system shall be an extension of the existing Tridium JACE based LON control system.

B. Automatic temperature controls field monitoring and control system using field programmable microprocessor based units with communications to Building Automation and Control System.

C. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment, with central and remote hardware, software, and interconnecting wire and conduit.

D. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

E. Provide controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, air handling units, chillers, pumps, unit ventilators, etc. when directly connected to control units. Individual terminal unit control is specified in Section 23 09 00.

F. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified.

G. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate the following:

1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
2. Connected data points, including connected control unit and input device.
3. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations. Submit demonstration diskette containing graphics.
4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
5. Description and sequence of operation for operating, user, and application software.
6. Use terminology in submittals conforming to ASME MC85.1.
7. Coordinate submittals with information requested in Section 23 09 93.

C. Product Data: Submit data for each system component and software module.

D. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.
2. Submit data specified in "Submittals" in final "Record Documents" form.

C. Operation and Maintenance Data:

1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.9 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

B. Furnish service and maintenance of control systems for two years from Date of Substantial Completion.

C. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

D. Perform work without removing units from service during building normal occupied hours.

E. Provide emergency call back service during working hours for this maintenance period.

F. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

G. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.

H. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE

A. Work Station Hardware: The workstation is existing to be reused.

2.2 DDC CONTROLS

A. Unit Controllers:

1. Programmable control module shall be pre-programmed prior to jobsite delivery for the applicable sequence of operation.

2.3 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

B. Control Units Functions:

1. Monitor or control each input/output point.
2. Completely independent with hardware clock/calendar and software to maintain control independently.
3. Acquire, process, and transfer information to operator station or other control units on network.
4. Accept, process, and execute commands from other control unit's or devices or operator stations.
5. Access both data base and control functions simultaneously.
6. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
7. Perform in stand-alone mode: Start/stop, duty cycling, automatic temperature control, demand control via a sliding window, predictive algorithm, event initiated control, calculated point, scanning and alarm processing, full direct digital control, trend logging, global communications, maintenance scheduling.
8. Global Communications: Broadcast point data onto network, making that information available to all other system control units.
9. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.

C. Input/Output Capability: Discrete/digital input (contact status), discrete/digital output, analog input, analog output, pulse input (5 pulses/second).

D. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control units with minimum 30 percent spare capacity.

2.4 LOCAL AREA NETWORKS (LAN)

A. Provide communication between network control units (NCU) over local area network (LAN). System must be capable of supporting Ethernet LAN between network control units.

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 10 MB as an Ethernet.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.5 OPERATING SYSTEM SOFTWARE

A. Provide input/output capability from operator station.

B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

C. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match.

D. Provide capability of dynamic color graphic displays if so noted on point charts.

E. Provide alarm processing.

F. Provide event processing.

G. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.

H. Provide message display.

I. Provide reports.

J. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.

K. Provide data collection.

L. Graphic Display: Support graphic development on work station with software features.

M. Provide maintenance management.

N. Provide advisories.

2.6 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Provide automatic time scheduling.

C. Provide start/stop time optimization.

D. Provide night setback/setup program.

E. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.

F. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.

G. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.

H. Provide fine tuning direct digital control PID or floating loops.

I. Provide trend logging.

2.7 HVAC CONTROL PROGRAMS

A. Support Inch-pounds and S.I. metric units of measurement. Identify each HVAC Control system.

B. Provide optimal run time.

C. Provide supply air reset.

D. Provide enthalpy switchover.

2.8 PROGRAMMING APPLICATIONS FEATURES

A. Provide trend logs.

B. Provide alarm messages.

C. Provide weekly scheduling.

D. Provide event interlocking.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify conditioned power supply is available to control units and to operator workstation.

C. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls were not subject to excessive vibration.

B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.

C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.

D. Install conduit and electrical wiring in accordance with Section 26 05 03.

E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Manufacturers' field services.

B. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.

C. Furnish service technician employed by system installer to instruct Owner's representative in operation of systems plant and equipment for 2 day period.

D. Contractors' tests and startups shall be scheduled and documented in accordance with the project requirements.

3.4 DEMONSTRATION AND TRAINING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Furnish basic operator training for 3 persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 16 hours instructor time. Furnish training on site.

C. Demonstrate complete and operating system to Owner.

D. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 01 77 00 for general contractor closeout requirements. Refer to individual sections for specific contractor training requirements.

END OF SECTION 230923

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sequence of Operations:

a. Steam boilers.
b. Control valves.
c. Boiler feedwater system.
d. Vacuum condensate pump.
e. Condensate pumps.
f. Ventilation unit.
g. Domestic water heater.
h. Emergency generator.
i. Heat exchanger.
j. Pumps.
k. Variable frequency drives.
l. Exhaust fans.
m. Phase monitoring.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.
2. Section 23 09 23 - Direct-Digital Control System for HVAC: For equipment, devices, system components, and software to implement sequences of operation.
3. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative. Refer to Section 01 70 00, Closeout Procedures, for substantial completion details.

1.2 SUBMITTALS

A. Section 01 30 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate mechanical system controlled and control system components.

1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
2. Submit flow diagrams for each control system, graphically depicting control logic.
3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
4. Submit valve and damper schedules.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.4 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. Temperature control system shall be DDC as specified in Section 23 09 23 “Direct Digital Control System for HVAC” and Section 23 09 00 “Instrumentation and Control for HVAC”.

B. Temperature control system shall be web-based and communicate seamlessly, via LON over the district's Ethernet LAN/WAN. All DDC control points listed in this section shall be performed by the DDC system and displayed on a PC browser with Internet Explorer. For future work, new DDC system software shall have capability and sufficient capacity to control entire building plus 20 percent spare capacity.

C. All DDC control points listed in this section shall be performed by the DDC system. Any other control work required to complete the sequence of operation herein specified shall be electric temperature controls. Contractor shall provide all wiring, conduit where required, transformers, relays, sensors, etc. necessary for a complete operating system. The entire control system specified herein shall be DDC.

D. All programming and point mapping shall be performed by the installing BAS contractor. All graphics associated with the controls work will be created and implemented under a separate contract by the school districts existing service provider.

3.2 STEAM BOILERS

A. The boiler control panel shall control the steam boilers. Panel installed and wired by BAS including sensors.

B. The steam boiler pressure shall be reset by outdoor air temperature. Submit reset schedule for approval. Reset schedule shall be adjustable.

C. Dedicated combustion air damper shall open/close when boilers start/stop (1 for each boiler).

D. Boilers shall be lead-lag and the lead boiler shall be alternated weekly, adjustable.

E. On a call for heat the combustion air damper shall be proven open prior to starting the boiler.

F. The BAS system shall enable and disable the boilers, boiler feedwater system and the vacuum condensate pump.

G. The BAS contractor shall wire the boiler components including blowdown panel, feedwater control, and all loose shipped manufacturer supplied components.

H. Manual emergency fuel burner switch located at each boiler room exit door shall shut off all burners, including domestic water heaters in Boiler Room when activated. One (1) switch is required at each boiler room exit door. See detail on plans.

I. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Steam Header Pressure	AI
2.	Steam Pressure Downstream of Boiler (each)	AI
3.	STB Status (each)	DI
4.	STB Start/Stop (each)	DO
5.	STB Alarm (each)	DI
6.	STB Pressure Setpoint	AO
7.	Combustion Air Damper Status (each)	DI
8.	Graphic Display	---

3.3 BOILER FEEDWATER SYSTEM

A. The boiler feedwater system shall be enabled whenever the boiler is enabled.

B. The boiler feedwater system shall operate on its own controls.

C. The BAS contractor shall wire all loose shipped items furnished by the equipment manufacturer.

D. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Feedwater Temperature	AI
2.	BFS Status	DI
3.	BFS Start/Stop	DO
4.	BFS Alarm	DI
5.	BFS High Water Alarm	AI
6.	BFS Low Water Alarm	AI
7.	Pump Status (each)	DI
8.	Pump Alarm (each)	DO
9.	Graphic Display	---

3.4 VACUUM CONDENSATE PUMP

A. The vacuum condensate pump shall be enabled whenever the boiler is enabled.

B. The vacuum condensate pump shall operate on its own controls.

C. The BAS contractor shall wire all loose shipped items furnished by the equipment manufacturer.

D. Input/Output Schedule (minimum points required):

	Description	Signal
1.	VCP Status	DI
2.	VCP Start/Stop	DO
3.	VCP Alarm	DI
4.	VCP High Water Alarm	AI
5.	Graphic Display	---

3.5 CONDENSATE PUMPS

A. The condensate pump shall be enabled whenever a boiler is enabled.

B. The condensate pump shall operate on its own controls.

C. The BAS contractor shall wire all loose shipped items furnished by the equipment manufacturer.

D. Input/Output Schedule (minimum points required):

	Description	Signal
1.	CP Status	DI
2.	CP Start/Stop	DO
3.	CP High Water Alarm	DI
4.	Graphic Display	---

3.6 VENTILATION UNIT

A. The unit shall be enabled by the BAS schedule. When the unit is enabled the outside air damper shall be opened to the minimum position. A minimum position switch is furnished with unit remote panel. The motor operated damper on the inlet of relief hood (RH-1) shall be interlocked to open when the outside air damper is open.

B. The unit modulating gas furnace shall be controlled by a discharge air thermostat and an overriding space thermostat.

C. During unoccupied times the unit shall be available for heating with the outside air damper closed.

D. The BAS contractor shall wire the remote panel and all loose shipped items furnished by the equipment manufacturer.

E. A smoke detector (manual reset) in the return air duct shall stop the unit, alarm the BAS and close the outside damper when the detector senses smoke.

F. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Supply Fan Status	DI
2.	Supply Fan Start/Stop	DO
3.	Discharge Air Temperature	AI
4.	Return Air Temperature	AI
5.	Low Limit Alarm	DI
6.	Filter Status	DI
7.	Smoke Air Detector	DI
8.	Outdoor Air Damper Actuator	AO
9.	Computer Graphic Display of System	All Points

3.7 MAIN BOILER ROOM DOMESTIC WATER HEATER ALARMS

A. BAS contractor shall pick-up boiler failure alarms for each of two domestic water heaters.

B. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Water Heater Status (each)	DI
2.	Water Heater Failure Alarm (each)	DI
3.	Computer Graphic Display of System	---

3.8 BOILER ROOM LOW TEMPERATURE ALARM

A. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Low Temperature Alarm (Boiler Room)	DI

3.9 SHELL AND TUBE HEAT EXCHANGER (HE-1 and HE-2), HOT WATER PUMPS (HWP-1 and HWP-2), VARIABLE FREQUENCY DRIVES (VFD-1 and VFD-2)

A. The heating system will automatically start when the outside air temperature falls below the system enable setpoint 68°F (adj) or the system enable is "ON". When the outside air temperature rises above this setpoint 68°F (adj) or the system enable is "OFF", the heating system will be disabled.

B. System equipment shall be enabled when water flow is established as indicated by flow switch.

C. This system consists of two steam heat exchangers each with a dedicated pump. Upon proof of flow the two sequenced steam inlet valves (1/3 - 2/3) will modulate in sequence to maintain the desired hot water supply temperature to setpoint as reset by the outdoor air temperature. The system will enable one heat exchanger and one pump and rotate to the other heat exchanger and pump based on run time.

D. System supply water temperature setpoint shall be reset from 120 degrees F. at 65 degrees F. outside air temperature to 200 degrees F. at 0 degrees F. outside air temperature (adjustable).

E. Should the enabled system not be able to maintain hot water set supply temperature the system will activate the standby heat exchanger, enable its associated hot water pump, and modulate the heat exchanger valves to meet setpoint. Upon meeting setpoint the system will slowly close the heat exchanger valves.

F. When enabled, the lead pump for the heat exchanger will be started. Upon loss of status, the stand-by pump will automatically start the lag system. Upon failure of a hot water pump or failure to produce the setpoint temperature, the system will shut down the enabled heat exchanger system, generate an alarm, and command the standby system on.

G. Heating system circulation pump shall operate continuously whenever main heating plant is in operation.

H. When a pump status is verified, the pump will be modulated to maintain the system differential pressure of the system. A variable frequency drive and differential pressure sensor shall vary the speed of the lead pump to will be modulated to maintain the differential pressure setpoint in the hot water loop.

I. Lead/standby status of heating system circulation pumps shall be alternated weekly so as to equalize run time on pumps.

J. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Heating system status	DI
2.	Hot water pump HWP-1 VFD start/stop	DO
3.	Hot water pump HWP-1 status	DI
4.	VFD-1 status	DI
5.	VFD-1 speed	AO
6.	Hot water standby pump HWP-2 VFD start/stop	DO
7.	Hot water standby pump HWP-2 status	DI
8.	VFD-2 status	DI
9.	VFD-2 speed	AO
10.	Hot water supply temperature	AI
11.	Hot water return temperature	AI
12.	Outside air temperature	AI
13.	Hot water differential pressure	AI
14.	Graphic Display	- -

3.10 EXHAUST FANS

A. Exhaust Fans (Group 1): Exhaust fans shall be controlled by a local switch shall have its run status monitored by the BAS.

B. Exhaust Fans (Group 2): Exhaust fans shall be controlled by a local switch shall have its run status monitored by the Building Automation System.

C. Exhaust Fans (Group 3 - EF-1): Exhaust fan on/off status shall be controlled by a wall mounted thermostat and monitored by the BAS.

D. BAS contractor shall wire the exhaust fan motor operated backdraft dampers.

E. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Exhaust Fan Status	DI
2.	Graphic Display	- -

3.11 EMERGENCY GENERATOR

A. When the emergency generator starts, the combustion air damper shall be opened.

B. Exhaust system (GHS.EF-1/GHS.IH-B3) shall be enabled whenever the emergency generator is active and will activated by room thermostat. They shall be inoperable when the emergency generator is off.

C. On a call for space cooling the motor operated dampers for exhaust system (GHS.EF-1 and GHS.IH-B3) shall be opened.

D. The speed of exhaust fan (GHS.EF-1) shall be varied through variable frequency drive (GHS.VFD-3) based on space temperature.

E. Input/Output Schedule (minimum points required):

	Description	Signal
1.	Generator Status	DI
2.	Exhaust Fan/VFD Start/Stop	DO
3.	Exhaust Fan/VFD Status	DI
4.	VFD Status	DI
5.	VFD Speed	AO
6.	Damper Status (each)	DI
7.	Graphic Display	- -

3.12 POWER/PHASE MONITORING

A. A phase monitor shall monitor each main power phase of the incoming service. Upon loss or imbalance of voltage for legs A, B, or C the building automation system shall shut-down and send an alarm to the BAS system the following equipment:

1. Pumps
2. Boilers
3. Variable frequency drives
4. Exhaust fans (3Ø only)

END OF SECTION 230993

SECTION 231123 - FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Natural gas piping above grade.
2. Unions and flanges.
3. Valves.
4. Pipe hangers and supports.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
2. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
4. ASME B31.9 - Building Services Piping.
5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
4. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
6. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

E. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

F. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

G. Underwriters Laboratories Inc.:

1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.9.

D. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:

a. Strainers.
b. Natural gas pressure regulators.
c. Natural gas pressure relief valves.

C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Shop Drawings: Submit piping fabrication drawings, drawn to scale not smaller than 1/4" = 1'-0" on drawing sheets the same size as the contract documents.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, piping system, and system components.

C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

A. Perform natural gas Work in accordance with NFPA 54.

B. Perform work in accordance with applicable code and local gas company requirements.

C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

D. Perform Work in accordance with authority having jurisdiction and AWS D1.1 for welding hanger and support attachments to building structure.

E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems.

1.12 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.13 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two packing kits for each type and size valve.

1.14 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
2. Joints: Threaded for pipe 2 inches and smaller (unless routed through the building outside of mechanical rooms); welded for pipe 2-1/2 inches and larger.

2.2 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with brazed joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 PIPE HANGERS AND SUPPORTS

A. Conform to NFPA 54 and ASME 31.9.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Support for Pipe 3 inches and Smaller: Cast iron hook.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

I. Sheet Lead: ASTM B749, 2.5 lb/sq ft inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with ASME B31.9.

B. Support horizontal piping hangers as scheduled.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Provide copper plated hangers and supports for copper piping and sheet lead packing between hangers or support and piping.

I. Prime coat exposed steel hangers and supports in accordance with Section 09 90 00.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.

L. Provide support for utility meters in accordance with requirements of utility company.

M. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00.

O. Install identification on piping systems including underground piping. Refer to Section 23 05 53.

P. Install valves with stems upright or horizontal, not inverted.

Q. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

R. Install gas pressure regulator with tee fitting between regulator and upstream shutoff valve. Cap or plug one opening of tee fitting.

S. Install gas pressure regulator with tee fitting not less than 10 pipe diameters downstream of regulator. Cap or plug one opening of tee fitting.

T. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.

U. Provide new gas service complete with gas meter and regulators. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

V. All gas piping within walls shall be welded, not screwed.

W. All exterior gas piping shall be scraped, primed, and painted with two (2) coats of oil based yellow paint specifically made for exterior metal applications.

3.6 FIELD QUALITY CONTROL

A. Pressure test natural gas piping in accordance with NFPA 54.

B. Inspect, test and purge gas piping in accordance with applicable code.

C. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Heating water piping, above ground.
2. Equipment drains and over flows.
3. Unions and flanges.
4. Pipe hangers and supports.
5. Valves.

B. Related Sections:

1. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product and execution requirements for expansion compensation devices use in heating and cooling piping systems.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, and firestopping for placement by this section.
3. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
4. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
5. Section 23 21 16 - Hydronic Piping Specialties: Product and execution requirements for piping specialties used in heating and cooling piping systems.
6. Section 23 21 23 - Hydronic Pumps: Product and execution requirements for pumps used in heating and cooling piping systems.
7. Section 23 25 00 - HVAC Water Treatment: Product and execution requirements for cleaning and chemical treatment of heating and cooling piping systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B31.1 - Power Piping.
6. ASME B31.9 - Building Services Piping.
7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

7. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
10. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
11. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
12. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
13. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
14. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
15. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
16. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
17. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
18. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
19. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
20. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
21. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
22. ASTM D3309 - Standard Specification for Polybutylene (PB) Plastic Hot- and Cold-Water Distribution Systems.
23. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
24. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
25. ASTM F441/F441M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
26. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
27. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
28. ASTM F845 - Standard Specification for Plastic Insert Fittings for Polybutylene (PB) Tubing.
29. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
30. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
31. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Provide pipe hangers and supports in accordance with ASME B31.1.

D. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.

F. Use spring loaded check valves on discharge of hot water, chilled water, or pumps.

G. Use plug valves for throttling service. Use non-lubricated plug valves only when shut-off or isolating valves are also provided.

H. Use butterfly valves in heating water systems, in chilled and condenser water systems in heating, chilled and condenser water systems interchangeably with gate and globe valves.

I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

J. Use only lug end butterfly valves.

K. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

L. Flexible Connectors: Use at or near pumps motor driven equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Shop Drawings: Submit pipe fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Piping layout.
3. Penetrations through fire rated and other walls.
4. Terminal unit and coil installations.
5. Hangers and supports, including methods for building attachment, and vibration isolation.

C. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, equipment and accessories.

C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems.

1.12 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two packing kits for each size and valve type.

1.13 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
2. Joints: Threaded for pipe 2 inches and smaller; welded for pipe 2-1/2 inches and larger.

B. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black, rolled grooved ends.

1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, compatible with steel piping sizes, rigid or flexible type.
b. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.

c. Accessories: Steel bolts, nuts, and washers.

C. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

D. Copper Tubing: ASTM B88, Type L, hard drawn, rolled grooved ends.

1. Fittings: ASME B16.18 cast copper alloy, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.
b. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
c. Accessories: Steel bolts, nuts, and washers.

E. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Acceptable Manufacturers: Viega and Ridged-Propress.
2. Press Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought.
3. Joints: Pressed by crimping tool.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

B. Copper Tubing: ASTM B88, Type K, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

C. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26, polyvinyl chloride (PVC) material (not to be utilized for boiler drains).

1. Fittings: ASTM D2466, Schedule 40, PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
4. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. PVC Piping: PVC flanges.
4. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 GATE VALVES

A. Manufacturers:

1. Milwaukee Valve Company.
2. NIBCO, Inc.
3. Stockham Valves & Fittings.
4. Apollo.

2.5 GLOBE VALVES

A. Manufacturers:

1. Milwaukee Valve Company.
2. NIBCO, Inc.
3. Stockham Valves & Fittings.
4. Apollo.

2.6 BALL VALVES

A. Manufacturers: (use only full port ball valves)

1. Milwaukee Valve Company.
2. NIBCO, Inc.
3. Stockham Valves & Fittings.
4. Apollo.

2.7 BUTTERFLY VALVES

A. Manufacturers: (use only full lug butterfly valves)

1. Milwaukee Valve Company.
2. NIBCO, Inc.
3. Stockham Valves & Fittings.
4. Apollo.

2.8 CHECK VALVES

A. Horizontal Swing Check Valves:

1. Manufacturers:

a. Crane Valve.
b. Milwaukee Valve Company.
c. NIBCO, Inc.
d. Stockham Valves & Fittings.
e. Apollo.

B. Spring Loaded Check Valves:

1. Manufacturers:

a. Milwaukee Valve.
b. NIBCO, Inc.
c. Stockham Valves & Fittings.
d. Apollo.

2.9 PIPE HANGERS AND SUPPORTS

A. Conform to ASME B31.1.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2-1/2 inches and Larger: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.

H. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

I. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.

J. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

K. Vertical Support: Steel riser clamp.

L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. Floor Support for Hot Pipe 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

O. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.

P. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

Q. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.3 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.9.

B. Support horizontal piping as scheduled.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Provide copper plated hangers and supports for copper piping or sheet lead packing between hangers or support and piping.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

J. Install pipe hangers and supports in accordance with Section 23 05 29.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install heating water and chilled water piping in accordance with ASME B31.1.

B. Route piping parallel to building structure and maintain gradient.

C. Install piping to conserve building space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 23 05 29.

G. Install pipe identification in accordance with Section 23 05 53.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

I. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

J. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

L. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

M. Install valves with stems upright or horizontal, not inverted.

N. Insulate piping and equipment.

O. Provide chain operated valves for those that are higher than 7’-0” above the finished floor.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Thermometer supports.
5. Test plugs.
6. Flexible connectors.
7. Air vents.
8. Strainers.
9. Pump suction fittings.
10. Combination pump discharge valves.
11. Flow controls.
12. Relief valves.
13. Air separators.
14. Expansion tank.

B. Related Sections:

1. Section 23 21 13 - Hydronic Piping: Execution requirements for piping connections to products specified by this section.
2. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

C. Underwriters Laboratories Inc.:

1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 PERFORMANCE REQUIREMENTS

A. Flexible Connectors: Provide at or near pumps and other motorized equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
4. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of actual locations of components and instrumentation.

C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.9 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 HYDRONIC INDICATORS

A. Manufacturers:

1. Miljoco Corporation.
2. Weiss Instruments.
3. Moeller Instruments
4. Palmer Instrument.

B. Gage: ASME B40.1 Grade A, accurate to 1%. Case to be 4.5" diameter, stem mounted, cast aluminum with stainless steel ring and unbreakable crystal. Indicator shall have recalibrator, compound scale calibrated both in PSI and feet from full vacuum to selected pressure. Maximum indicator pressure shall at minimum equal pump shut-off head (when system pressure is at relief valve setting) and shall exceed his minimum by no more than 50 psi.

C. Manifold valve shall be spring return push-button manifold of rugged brass construction with ports for connection to system at indicated points and with test port connection for gauge calibration.

D. Hydronic indicator system shall be attached to system piping with heavy bracket at convenient height to permit easy push-button operation and dial observation.

2.2 PRESSURE GAGES

A. Manufacturers:

1. Miljoco Corporation.
2. Weiss Instruments.
3. Moeller Instruments.
4. Palmer Instrument.

B. Pressure Gage:

1. Type: General use, ASME B40.1 Grade B, phosphor bronze bourdon tube, bottom connection.
2. Case: Black finished drawn steel.
3. Size: 2-1/2 inch diameter.
4. Mid-Scale Accuracy: Plus or minus two percent of range span.
5. Scale: White with black markings.
6. Range: Psi with equivalent kPa. Span to be two times the system operating pressure.
7. Connection: Brass, 1/4 inch NPT.

C. Pressure Gage Tappings:

1. Ball Valve: Lever handle, brass 1/4 inch NPT for maximum 150 psig.
2. Needle Valve: Brass, 1/4 NPT for minimum 150 psig.
3. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.
4. Snubber: Brass bushing, 1/4 inch NPT with corrosion resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Miljoco Corporation.
2. Weiss Instruments.
3. Moeller Instruments.
4. Palmer Instrument.

B. Thermometer

1. Case: Nine inch die cast aluminum with hard power coated finish.
2. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
3. Tube: Non-toxic organic spirit-filled glass tube with magnifying lens.
4. Scale: Aluminum with white finish and black markings.
5. Stem: Aluminum or brass.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and cable when required.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with aluminum perforated stem.

2.5 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F. Viton core for temperatures up to 400 degrees F. Extend as required to be accessible with insulated pipe.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapter with 1/8 inch probe, two 1-1/2 inch dial thermometers.

2.6 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:

1. Manufacturers:

a. Bell & Gossett, ITT.
b. Armstrong.
c. Taco.

2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
3. High Capacity: Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

2.7 STRAINERS

A. Acceptable Manufacturers:

1. Nibco.
2. Milwaukee.
3. Stockham.
4. Keckley.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.8 PUMP SUCTION FITTINGS

A. Manufacturers:

1. Bell & Gossett, ITT.
2. Armstrong.
3. Taco.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.9 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturers:

1. Bell & Gossett, ITT.
2. Armstrong.
3. Taco.

B. Valves: Straight pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.10 CIRCUIT BALANCING VALVES

A. Manufacturers:

1. Bell & Gossett.
2. Taco.
3. Armstrong.
4. Illinois.
5. HCI.
6. Oventrop.

B. Orifice principle by-pass circuit with direct reading gage, soldered or flanged piping connections for 125 psig (860 kPa) working pressure, with shut off valves, and drain and vent connections.

C. Direct reading with insert Pitot tube, threaded coupling, for 150 psig working pressure, maximum 240 degrees F, 5 percent accuracy.

D. 2 1/2 Inch and Larger: Cast iron, wafer type, orifice insert flow meter for 250 psig (1720 kPa) working pressure, with read-out valves equipped with integral check valves with gasketed caps. Provide butterfly valve with memory stop for balancing.

E. 2 1/2 Inch and smaller: Calibrated, ball type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

F. Provide manufacturer furnished molded insulated valve covers.

2.11 RELIEF VALVES

A. Manufacturers:

1. Bell & Gossett, ITT.
2. Armstrong.
3. Watts.

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.12 AIR SEPARATORS

A. Manufacturers:

1. Bell & Gossett, ITT.
2. Armstrong.
3. Taco.

B. Steel, tested and stamped in accordance with ASME SEC 8-D; for 125 psig operating pressure, with integral galvanized steel strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

C. Furnish air separators of quantities and sizes indicated on the piping diagrams with tangential nozzles and stainless steel air collector tube with five thirty-seconds inches (5/32") diameter perforations and sixty-three percent (63%) open area designed to trap free air and direct it into the compression tank. The air separator shall be fitted with a NPT vent to the air separator. A NPT tapping shall be provided on the bottom of the air separator to facilitate periodic blowdown.

D. The air separator shall also be equipped with a galvanized steel system strainer with three-sixteenth inches (3/16") diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe. Models with system strainer are also equipped with a blowdown nozzle to facilitate removal of the strainer for periodic routine cleaning.

E. The air separator must be designed, constructed and stamped for one hundred twenty-five (125) psig at three hundred fifty degrees (350°) F. in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with The National Board of Boiler and Pressure Vessel Inspectors. The air separators shall be painted with one shop coat of light gray air dry enamel.

F. A manufacturer’s Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.

2.13 EXPANSION TANKS AND ACCESSORIES

A. Manufacturers:

1. Bell & Gossett, ITT.
2. Wessels.
3. Amtrol.
4. Taco.

B. Pressurized expansion tank shall be of a vertical design with a heavy-duty replaceable bladder. The unit shall be constructed of a welded steel shell ASME rated and stamped for 125 PSIG, working pressure installations (where noted 200 or 250 PSI working pressure may be required). The unit shall have a replaceable type bladder constructed of a heavy duty Butyl rubber material. The bladder shall be capable of filling the entire inside volume of the tank. The bladder shall be fixed in place by a flange assembly and shall have a flexible internal sparging tube to minimize bladder failures. The unit shall have a flanged bladder connection for ease of bladder removal and service as well as a NPT system connection. The unit shall be fitted with lifting rings, a floor mounted skirt for vertical installation, a NPT drain plug, an a .302" – 32 charging valve (standard tire valve) connection to facilitate on-site charging of the tank to meet system requirements. The tank comes precharged from the factory at 12 PSIG, but must be field charged, in accordance with the manufacturer's installation manual, to the same pressure as the system's pressure fill valve is set to maintain, on the system.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping

C. Install pressure gages with pulsation dampers. Provide needle valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, and where indicated on Drawings.

B. Where large air quantities accumulate, provide enlarged air collection standpipes.

C. Install manual air vents at system high points.

D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide drain and hose connection with valve on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide radiator valves on water inlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.

K. Provide radiator-balancing valves on water outlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.

L. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

M. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

N. Pipe relief valve outlet to nearest floor drain.

O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting installed construction.

B. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-line circulators.
2. Base mounted pumps.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 21 13 - Hydronic Piping: Execution requirements for connection to pumps specified by this section.
3. Section 23 21 16 - Hydronic Piping Specialties: Product and execution requirements for piping specialties installed in hydronic systems adjacent to pumps.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:

1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pumps.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one set of mechanical seals for each pump.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Manufacturers:

1. Bell & Gossett/ITT or owner approved equal.

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Stamped brass or cast bronze, keyed to shaft.

E. Bearings: Two, oil lubricated bronze sleeves.

F. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Carbon rotating against a stationary ceramic seat, 250 degrees F maximum continuous operating temperature.

H. Drive: Drop out type flexible coupling.

2.2 BASE MOUNTED PUMPS

A. Manufacturers:

1. Bell & Gossett/ITT or owner approved equal.

B. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 175 psig maximum working pressure.

C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed to shaft.

E. Bearings: Grease lubricated roller or ball bearings.

F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

G. Seal: Internally flushed, carbon rotating against a stationary ceramic seat, Buna-N fitted, 250 degrees F maximum continuous operating temperature.

H. Drive: Drop out type flexible coupling with coupling guard.

I. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Provide a minimum of five (5) pipe diameter of straight pipe between pump suction and an elbow or provide a suction diffuser. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

C. Install flexible connectors at or near pumps and motorized equipment where piping configuration does not absorb vibration.

D. Provide line sized shut-off valve, strainer, and combination pump discharge valve (triple duty valve) on pump discharge. Refer to pump detail on drawings.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals.

G. Lubricate pumps before start-up.

H. Provide side-stream filtration system for heating and cooling water systems. Install across pump with flow from pump discharge to pump suction from pump taps.

I. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

J. Check, align, and certify alignment of base mounted pumps prior to start-up.

3.2 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION 232123

SECTION 232213 - STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following for low pressure steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Safety valves.
4. Steam traps.
5. Thermostatic air vents and vacuum breakers.
6. Valves.
7. Formed steel channel.
8. Firestopping relating to HVAC work.
9. Firestopping accessories.

1.2 DEFINITIONS

A. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.3 SUBMITTALS

A. Product Data: For each type of the following:

1. Safety valve and drip pan elbows.
2. Steam trap.
3. Air vent and vacuum breaker.
4. Valves.

B. Shop Drawings: Detail, 1/4 inch equals 1 foot scale, equipment and fabrication piping layout, assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves, safety valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label

E. Submit written reports documenting the activities required to be performed in Part 3. These reports are to be submitted two weeks after the startup is completed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer's recommendations for handling, unloading and storage.

B. Storage: Store per manufacturer's written recommendations. Store indoors in a warm, clean, dry place where pipe will be protected from weather, construction traffic, dirt, dust, water and moisture.

1.6 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. LP Steam Piping: 15 psig.
2. Condensate Piping: condensate pumps pressure in psig at 250 deg F.
3. Makeup-Water Piping: 80 psig at 150 deg F.
4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.7 WARRANTY

A. Written manufacturer's warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Dielectric Unions:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries, International Inc.
d. Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group.

2. Dielectric Flanges:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Water Technologies, Inc.

3. Dielectric-Flange Kits:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

4. Strainers: "Y" Pattern of Basket:

a. Spence Engineering.
b. O.C. Keckley Company.
c. Illinois Engineering

5. Bronze or Brass Safety Valves (NPS ½ through 2-1/2"):

a. Spence Engineering
b. O.C. Keckley Company
c. Illinois Engineering

6. Cast-Iron Safety Valves (NPS 3" through 6"):

a. Spence Engineering
b. O.C. Keckley Company
c. Illinois Engineering

7. Float and Thermostatic Traps:

a. Illinois Engineering
b. Nicholson Steam Trap; Division of Circor Fluid Technologies
c. Mepco

8. Thermostatic Steam Traps:

a. Illinois Engineering
b. Nicholson Steam Trap; Division of Circor Fluid Technologies
c. Mepco

9. Vacuum Breakers:

a. Illinois Engineering
b. Nicholson Steam Trap; Division of Circor Fluid Technologies
c. Mepco

10. Valves:

a. Nibco.
b. Milwaukee.
c. Stockham.

11. Spring Loaded Check Valves:

a. Euroblock.
b. Keckley.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K

C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.

C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure as required to suit system pressures.

2.6 VALVES

A. Gate, Globe, Check, and Ball Valves: Comply with requirements specified below:

1. Gate Valves:

a. Up To and Including 2 Inches:

1) 150# class, bronze body, bronze trim, union bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc, threaded ends.

b. Over 2 Inches:

1) 125# class, iron body, bronze trim, bolted bonnet, rising handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

c. Provide chain operators when valves are located 7’-0” or more above the working surface.

2. Globe Valves:

a. 2 inches and Smaller: MSS SP 80, Class 150, bronze body, bronze trim, union bonnet, rising stem, composition disc, threaded ends.
b. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends.

3. Swing Check Valves:

a. Up To and Including 2 Inches:

1) 150# class, bronze or iron body, bronze trim, bronze rotating swing disc with composition seat, solder ends.

4. Spring Loaded Check Valves:

a. 1 1/2 inches and Smaller: MSS SP 80, Class 400, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, threaded ends.
b. 2 inches and Larger: MSS SP 71, Class 125, lug style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

5. Ball Valves:

a. Up To and Including 2-1/2 Inches:

1) 400# class, bronze stainless steel two piece body, full port chrome plated bass ball, Teflon seats and stuffing box ring, lever handle solder ends.

2.7 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

B. Basket Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 250-psig working steam pressure.

2.8 SAFETY VALVES

A. Bronze or Brass Safety Valves (NPS ½ through 2-1/2”):

1. Disc Material: Forged copper alloy.
2. End Connections: Threaded inlet and outlet.
3. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
4. Pressure Class: 250.
5. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
6. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves (NPS 3” through 6”):

1. Disc Material: Forged copper alloy with bronze nozzle.
2. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
3. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
4. Pressure Class: 250.
5. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
6. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.9 STEAM TRAPS

A. Float and Thermostatic Traps:

1. Body and Bolted Cover: ASTM A 126, cast iron, 125 psi class.
2. End Connections: Threaded.
3. Diaphragm Cover: Forged brass.
4. Float Mechanism: Seamless copper float.
5. Valve Mechanism: Hardened stainless steel.
6. Head and Seat: Hardened stainless steel.
7. Trap Type: Balanced pressure, intermittent discharge, constant flow not acceptable.
8. Thermostatic Bellows: Duplex phosphor bronze with stainless steel valve cone.
9. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
10. Maximum Operating Pressure: 25" Hg. vacuum to 15 psig.
11. Maximum Allowable Working Pressure: 175 psig.

2.10 THERMOSTATIC STEAM TRAPS AND VACUUM BREAKERS

A. Thermostatic Steam Traps:

1. Body: Cast bronze, forged brass or stainless steel bodies not acceptable.
2. End Connections: Threaded with brass union and tailpiece.
3. Thermostatic Element: Duplex phosphor bronze with stainless steel valve cone.
4. Maximum Operating Pressure: 25" Hg. vacuum to 15 psig
5. Maximum Allowable Working Pressure: 125 psig.

B. Vacuum Breakers:

1. Body: Cast iron, bronze, or stainless steel.
2. End Connections: Threaded.
3. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
4. O-ring Seal: EPR.
5. Pressure Rating: 125 psig.
6. Maximum Temperature Rating: 350 deg F.

2.11 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel minimum with holes 1-1/2 inches on center.

2.12 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single or Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

2.13 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. LP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above and below grade, NPS 2 and smaller, shall be the following:

1. Schedule 80, Type S, Grade B, steel pipe; Class 250 cast-iron fittings; and threaded joints.

D. Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:

1. Schedule 80, Type E, Grade B, steel pipe; Class 250 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 ANCILLARY PIPING APPLICATIONS

A. Makeup-water piping installed above grade shall be the following:

1. Drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

C. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

D. Vacuum-Breaker Piping: Outlet, same as service where installed.

E. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.4 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.

P. Install valves with stems at or above horizontal.

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as required.

U. Identify piping as specified in Section 230553 “Mechanical Identification”.

V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.
3. Install pressure gage on low-pressure steam outlet according to Section 232216 “Steam and Condensate Piping Specialties.”

W. All valves over 7’-0” above the finish floor shall have chain operators.

3.5 STEAM-TRAP PERFORMANCE / INSTALLATION

A. Select and size steam traps to provide a minimum of either 100 percent of the condensing rate of the equipment on which it is installed, at 1/2 psig differential pressure or 2-1/2 times the condensing rate of the equipment being drained at 5 psig inlet pressure to the steam trap whichever capacity is the larger. Where the required capacity exceeds the manufacturer’s catalog rating, provide multiple traps.

B. Select LP steam traps for a pressure drop of 1/2 psig differential pressure.

C. Provide Float & Thermostatic steam traps on all (steam mains, heat exchangers, heating coils, unit heaters, boiler headers, drip legs, end of mains, etc.) LP apparatus.

D. Install minimum 18 to 24 inch vertical drip leg between equipment/main/header and inlet of steam trap.

E. Install steam traps in accessible locations as close as possible to connected equipment.

F. Install gate valve, strainer, and union upstream from trap; install union, check valve, and gate valve downstream from trap unless otherwise indicated.

3.6 SAFETY VALVE INSTALLATION

A. Pipe safety-valve discharge without valves to atmosphere outside the building.

B. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

C. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.7 HANGERS AND SUPPORTS

A. Install hangers and supports according to Section 230529 “Hangers and Supports”. Comply with requirements below for maximum spacing.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 9 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 9 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 21 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 24 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 26 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 30 feet; minimum rod size, 7/8 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 4 feet; minimum rod size, 1/4 inch.
2. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.8 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook", using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.9 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.

C. Install vacuum breakers downstream from control valve, close to coil inlet connection.

D. Install a drip leg at coil outlet.

3.10 CONTRACTOR STARTUP AND REPORTING

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping", and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping as specified in section 230590 Testing of Piping.

C. Prepare written report of testing.

END OF SECTION 232213

SECTION 232216 - STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low Pressure Condensate Pumps.
2. Hydronic Indicators.
3. Pressure Gages and Pressure Gage Taps.
4. Thermometers and Thermometer Wells.
5. Shell and Tube Heat Exchanger.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product and execution requirements for expansion compensation devices use in heating and cooling piping systems.
3. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves used in steam and steam condensate piping systems.
4. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, and firestopping for placement by this section.
5. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
6. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for connection to pumps specified by this section.
7. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and execution requirements for piping specialties installed in steam systems.
8. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 8-D - Rules for Construction of Pressure Vessels.

B. ASME B31.9 - Building Services Piping.

C. ASTM A105 - Forgings, Carbon Steel, for Piping Components.

D. ASTM A126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.

E. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

F. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum).

H. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Use Thermostatic Steam Traps for:

1. Steam radiation units.
2. Convectors.
3. Unit ventilators.
4. Other similar terminal heating units.

B. Use Float and Thermostatic Traps for:

1. Rise and drip locations.
2. Main headers.
3. Branch lines.
4. Boiler drain traps.

1.4 PERFORMANCE REQUIREMENTS

A. Steam Traps:

1. Select to handle minimum of two times maximum condensate load of apparatus served.
2. Pressure Differentials:

a. Low Pressure Systems 5 psi and less: 1/2 psi.
b. Low Pressure Systems 15 psi maximum: 2 psi.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data:

1. Provide for manufactured products and assemblies required for this project.
2. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
4. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Shop Drawings: Provide 1/4" scale drawings indicating equipment, ductwork, control valves, shut-off valves, pipe elevations, etc. prior to fabrication.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 77 00.

B. Operation and Maintenance Data: Include installation instructions, servicing requirements, and recommended spare parts lists.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Section 01770.

B. Provide two service kits for each size and type of steam trap.

C. Provide one set of mechanical seals for each pumps.

PART 2 - PRODUCTS

2.1 LOW PRESSURE CONDENSATE PUMPS

A. Manufacturers:

1. Subject to compliance with requirements, provide products by one of the following:

a. MEPCO Pump Packages Division of Vent Rite Valve.
b. Federal Pump Corporation.
c. Skidmore Pump Company.

B. Description: Receiver mounted, consisting of centrifugal condensate pump and motor assemblies mounted to cast iron chamber, and automatic pressure and water temperature controls. Include the following accessories:

1. Thermometer: 3-Inch Stainless Steel Dial Register in Fahrenheit
2. Gauge Glass: Stops top and bottom on each chamber
3. Pump Suction Isolation Butterfly Valves
4. Companion flanges
5. Overflow Drain
6. Discharge Valves
7. Spring Loaded Check Valves
8. Discharge Pump Pressure Gauges
9. Float Control Valves
10. Electric Controls and Accessories

C. Receiver Material: Separation Chamber and Accumulator Chamber Close-Grained Cast Iron.

1. Finish: Painted exterior.

D. Vertical Duplex Condensate Pumps: Mounted with suction isolation valve, closed-coupled, bronze fitted, enclosed impeller, centrifugal pumps rated for 75-psig minimum working pressure and a continuous water temperature of 225 deg F; furnished with the following features:

1. Impeller: Cast Bronze.
2. Shaft: Stainless steel.
3. Seals: Mechanical (225° F rated).
4. Motor: TEFC.

E. Condensate Unit Control Panel: Furnish unit mounted, factory wired with seal tight conduit on units with operating voltages of 208, 3 phase, and including the following:

1. NEMA 4X, Type Enclosure.
2. Combination magnetic starters for each condensate pump motor with three overload relays, one (1) circuit breaker disconnect switch with cover interlock for each set of two (2) condensate pump motors.
3. Numbered terminal block.
4. Removable control mounting plate.
5. Fusible control-circuit transformer where motor voltage exceeds 130 V.
6. Two (2) “Hand-Off-Automatic” Selector Switches
7. Two (2) “Test” Selector Switches
8. Two (2) Pump Run Lights

F. Condensate Pump Control Sequence: Selector switch in automatic position (float), cycle lead condensate water removal pump such that an increase in the tank water level shall start the lead pump as determined by the mechanical alternator. If the lead pump cannot handle the return condensate or the lead pump fails to function the lag pump shall start.

G. Motors: Comply with requirements in Section 230513 “Motors.”

2.2 HYDRONIC INDICATORS

A. Gage: ASA Grade A, accurate to 1%. Case to be 4.5" diameter, stem mounted, heavy steel with screwed ring and unbreakable crystal. Indicator shall have recalibrator, compound scale calibrated both in PSI and feet from full vacuum to selected pressure and quick-set dial for pressure comparison. Maximum indicator pressure shall at minimum equal pump shut-off head (when system pressure is at relief valve setting) and shall exceed this minimum by no more than 50 psi.

B. Manifold valve shall be spring return push-button manifold of rugged brass construction with ports for connection to system at indicated points and with test port connection for gauge calibration.

C. Hydronic indicator system shall be attached to system piping with heavy bracket at convenient height to permit easy push-button operation and dial observation.

2.3 PRESSURE GAGES

A. Gage: ASME B40.1, drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 2 1/2 inch diameter.
3. Mid-Scale Accuracy: Two percent.
4. Scale: Psi.

2.4 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psig.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psig.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.5 STEM TYPE THERMOMETERS

A. Thermometer: ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass.
4. Accuracy: ASTM E77 2 percent. Degrees F.

2.6 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.7 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F. Nordel core for temperatures up to 350 degrees F. Viton core for temperatures up to 400 degrees F.

2.8 SHELL & TUBE, U-TUBE HEAT EXCHANGER:

A. Manufacturer:

1. Contractor shall furnish and install new shell and tube heat exchanger for the heating systems as indicated on the drawings.

a. Bell & Gossett.
b. MEPCO.
c. Armstrong.

B. Heat exchanger shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings.

C. A steam to water (model SU) removable U-Tube type heat exchanger of the sizes and capacities noted on the schedule. The heat exchanger shall consist of 3/4” OD copper tubes, cast iron head of two pass configuration, steel shell, tubesheet and supports. Unit’s shell and tubes shall be specifically designed for 150 PSIG working pressure at 375°F.

D. Tubes shall be of 3/4” O.D. 20 gauge copper and shall be secured to a steel tubesheet via rolled joints.

E. Heat exchanger shall be constructed of a cast iron or fabricated steel head, steel shell, and steel baffles, tie rods, and spacers. Unit shall have a compressed fiber gasket to seal the shell at the tubesheet.

F. Heat exchanger design shall allow for a maximum tubeside velocity no greater than 7.5 feet/ second and a shell side velocity no greater than 4.0 feet/second. Unit shall be constructed with a fouling factor equal too or greater than that scheduled. Unit diameter shall be no less than 8 inches and the bundle length shall be no greater than that scheduled.

G. Heat exchanger shall be provided with the scheduled square footage of heat transfer area.

H. Unit shall be constructed in accordance with ASME Code Rules and shall have a manufacturer’s data report for pressure vessels, form No. U-1. Form U-1 shall be furnished to the engineer for the owner with the heat exchanger submittal. An authorized inspector, holding a National Board commission, certifying that construction conforms to the latest ASME Code for pressure vessels must sign this form. The ASME "U" symbol should also be stamped on the Heat Exchanger(s). In addition, each unit registered with the National Board of Boiler and Pressure Vessel Inspectors.

I. Heat exchanger manufacturer shall be ISO-9001 certified.

J. Where indicated heat exchanger shall be provided with alternate materials of construction as noted on schedule and installation drawings

K. Steam heat exchanger shall be provided with the proper vacuum breaker and/or vent as required. See details on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Steam Traps:

1. Provide minimum trap size as scheduled on the drawings.
2. Install with union or flanged connections at both ends.
3. Provide gate valve and strainer at inlet, and gate valve and check valve at discharge.
4. Provide a drip leg between apparatus and trap and a dirt leg below the trap inlet. See drip station details on the drawings.

C. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.

D. Install condensate return units on 4" concrete housekeeping pad. Install all devices shipped loose by manufacturer and provide control wiring in conduit to all remote device locations as recommended by manufacturer for a complete operating system.

E. Provide factory start-up and Owner training for condensate pumps provided under this section.

END OF SECTION 232216

SECTION 232223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electric-driven positive displacement vacuum condensate pumps.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for connection to pumps specified by this section.
3. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and execution requirements for piping specialties used in steam piping systems.
4. Section 23 52 39 - Fire-Tube Boilers: Boilers serving steam systems.
5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 SUBMITTALS

A. Product Data: Include performance curves and rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Indicate pump's operating point on curves. Include receiver capacity and material.

B. Shop Drawings: Include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, method of field assembly, and attachments to other work. Provide submittal drawings with dimensional information for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

D. Startup Reports: Submit reports documenting the activities required to be performed in Part 3. These reports are to be submitted two weeks after the startup is completed.

E. Training Reports: Submit reports on training documenting dates and attendance.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain positive displacement vacuum condensate pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with suitable protective covers or with screwed-in plugs.

B. Store positive displacement vacuum condensate pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.6 WARRANTY

A. Written manufacturer’s warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

PART 2 - PRODUCTS

2.1 POSITIVE DISPLACEMENT VACUUM CONDENSATE PUMP UNIT

A. Manufacturers:

1. Subject to compliance with requirements, provide products by one of the following:

a. Electric Driven Positive Displacement Vacuum Condensate Pumps:

1) MEPCO Pump Packages Division of Vent Rite Valve.
2) Federal Pump Corporation.

B. Description: Receiver mounted, consisting of positive displacement vacuum air removal liquid ring pumps and motor assemblies mounted to cast iron separation chamber, centrifugal condensate pump and motor assemblies mounted to cast iron accumulator chamber, and automatic pressure and water temperature controls. Include the following accessories:

1. Thermometer: 3-Inch Stainless Steel Dial register in Fahrenheit on each chamber.
2. Vacuum Gage: 4-Inch Stainless Steel Dial-type register in inches of mercury.
3. Gage Glass: Stops top and bottom on each chamber.
4. Air-suction check valve.
5. Lifting eyes.
6. Companion flanges.
7. Low-water make-up switch on separation chamber.
8. Cooling-Water Control: Aquastat, inlet strainer; and packless, piston-pilot, electric solenoid valve.
9. Air vent.
10. Overflow Drain: Overflow drain from vacuum-producer receiver.
11. Discharge Muffler Silencers for each air removal pump.
12. Vacuum Control Switches for each air removal pump.
13. Inlet Basket Strainer.
14. Discharge Valves.
15. Pump Suction Isolation Valves.
16. Vacuum and Float Controls.
17. Electric Controls and Accessories.

18. Vacuum Breaker.
19. Water Storage and Condensate Accumulator - 3/16" cast iron.

C. Receiver Material: Separation Chamber and Accumulator Chamber Close-Grained 3/16" thick Cast Iron.

1. Finish: Painted exterior.

D. Horizontal Positive Displacement Vacuum-Air Removal Pumps: Mounted with suction isolation valve, closed-coupled, positive displacement single-stage, liquid ring, water cooled pumps rated for 75-psig minimum working pressure and a continuous water temperature of 225 deg F; capable of removing the stated required cfm of air at a rating of 15" Hg. Vacuum, 5.5" Hg. Vacuum rating will not be acceptable, furnished with the following features:

1. Rotor: Cast Bronze.
2. Shaft: Stainless steel.
3. Seals: Mechanical (225° F rated).
4. Motor: Totally Enclosed Fan Proof.

E. Vertical Condensate Pumps: Mounted with suction isolation valve, closed-coupled, bronze fitted, enclosed impeller, centrifugal pumps rated for 75-psig minimum working pressure and a continuous water temperature of 225 deg F; furnished with the following features:

1. Impeller: Cast Bronze.
2. Shaft: Stainless steel.
3. Seals: Mechanical (225° F rated).
4. Motor: Totally Enclosed Fan Proof.

F. Vacuum Unit Control Panel: Unit mounted, factory wired with seal tight conduit, and including the following:

1. NEMA Type 4X, enclosure.
2. Combination magnetic starters for each air pump motor and each condensate pump motor with circuit breakers and three overload relays, one (1) circuit breaker disconnect switch with cover interlock for each set of two (2) air pump motors and each set of two (2) condensate pump motors.
3. Two (2) Vacuum Switches for Duplex Vacuum-Air Removal Pumps with vacuum adjustment, factory set.
4. Numbered terminal block.
5. Removable control mounting plate.
6. Electric alternator for air removal duplex units.
7. Four (4) Pilot lights for pump running of each air removal pump and each condensate pump.
8. Fusible control-circuit transformer where motor voltage exceeds 130 V.
9. One (1) Temperature Limit Switch, One (1) Float Switch in Upper Separation Chamber Compartment and One (1) Mechanical Alternating Float Switch in Lower Accumulator Storage Compartment.
10. Four (4) "Test" Switches
11. Four (4) "Hand-Off-Automatic" Selector Switches.
12. Four (4) Pump Failure Lights

G. Vacuum-Air Removal Control Sequence: Selector switch in automatic position (vacuum), cycle lead air removal pump as determined by the electrical alternator to maintain vacuum set point. If lead pump cannot remove the required amount of air as system demand requires or the lead pump, fails to function then the lag pump shall start. Pumps shall cycle via the electrical alternator.

H. Condensate Pump Control Sequence: Selector switch in automatic position (float), cycle lead condensate water removal pump such that an increase in the tank water level shall start the lead pump as determined by the mechanical alternator. If the lead pump cannot handle the return condensate or the lead pump fails to function the lag pump shall start.

I. Motors: Comply with requirements in Section 230513 “Motors.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine rough installation of steam condensate piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, rotors, impellers, and accessories.

B. Support pumps and piping separately so piping is not supported by pumps.

C. Install pumps on concrete bases. Anchor pumps to bases using inserts or anchor bolts.

D. Install thermometers and pressure gages.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections 232213. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install inlet basket strainer and gate valve at pump suction. Install check valve, ball valve, and globe valve at pump discharge connections for each electric-driven condensate pump.

D. Pipe drain to nearest floor drain for overflow and drain piping connections.

E. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.

F. Ground equipment according to Section 260503.

G. Connect wiring according to Section 260503.

3.4 CONTRACTOR STARTUP AND REPORTING

A. Verify that positive displacement vacuum condensate pumps are installed and connected according to the Contract Documents. Provide factory startup service that includes the testing, inspections and startup test reports.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Clean strainers.

D. Set positive displacement vacuum condensate pump controls.

E. Set pump controls for automatic start, and stop operation.

F. Perform the following preventive maintenance operations and checks before starting:

1. Set float switches to operate at proper levels.
2. Set throttling valves on pump discharge for specified flow.
3. Check motors for proper rotation.
4. Test pump controls and demonstrate compliance with requirements.
5. Replace damaged or malfunctioning pump controls and equipment.
6. Verify that pump controls are correct for required application.

G. Start positive displacement vacuum condensate pumps according to manufacturer's written startup instructions.

3.5 DEMONSTRATION AND COMMISSIONING

A. Demonstration: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain positive displacement vacuum condensate pumps. Refer to Section 01 77 00 - “Closeout Procedures.”

1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintenance. The training will occur after the startup report has been provided to the owner and the trainer will provide two (2) Installation and Operations manuals for the use of the owner’s personnel during training.
2. Review data in maintenance manuals. Refer to Section 01 77 00 - “Operation and Maintenance Data.” All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

B. Demonstrate proper operation of equipment to owner’s agent. The scope of the demonstration will include functional performance requirements under both local and building automation control as well as commissioning requirements.

END OF SECTION 232223

SECTION 232500 - HVAC STEAM AND WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System cleaner.
2. Closed system treatment equipment.
3. Chemicals.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections specified by this section.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

C. Product Data: Submit chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit placement of equipment in systems, piping configuration, and connection requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Manufacturers Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout products.

B. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

C. Operation and Maintenance Data: Submit data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of Illinois standard for addition of non-potable chemicals to building systems and for discharge to public sewers.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience and with service facilities within 100 miles of Project with water analysis laboratories and full time service personnel.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish chemicals for treatment and testing during warranty period.

1.8 OPERATION AND MAINTENANCE DATA

A. Refer to General Conditions, Division 1.

B. Include data on all equipment, including spare parts lists, and products data and NSDS for all chemical treatments required.

C. Include step by step instructions on testing procedures, including target concentrations.

1.9 MAINTENANCE SERVICE

A. Provide service and maintenance of the water treatment systems, including chemical treatment products, for control of scale formation, corrosion, and microbiological growth in all treated systems from the date of start-up through the warranty period, or for a maximum of one (1) year, whichever comes first.

B. Provide semi-annual technical service calls and perform field inspections including on-site water analysis of all treated systems. Detail findings in a written report, including chemical testing results and corrective actions needed.

C. Provide laboratory and technical assistance for warranty period.

D. Provide comprehensive operator training, including care, maintenance, testing and operation of water treatment systems.

E. Provide on-site inspection of equipment during scheduled shutdowns to properly evaluate success of water treatment program and make recommendations in writing based upon these inspections.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All items in this section shall be provided by a single water treatment firm and shall be Geen Industries, Inc., contact: Curt Green or owner approved equal.

2.2 SYSTEM CLEANER

A. Provide a liquid alkaline cleaner with emulsifying agents to remove grease, oil, and dirt from the boilers and related feed equipment.

2.3 WATER SOFTENERS

A. The owner shall provide a duplex unit capable of handling 40 gpm peak flow rate. One unit will be on-line while the other unit regenerates and remains on standby.

2.4 CHEMICAL FEED PUMPS

A. Provide three (3) chemical feed pumps similar to the Pulsafeeder Series A-Plus with a maximum capacity of 12 gal./day GPD. The pumps will be activated whenever a boiler is calling for feedwater. Power and interlock wiring shall be by the chemical treatment contractor.

2.5 WATER METER

A. Provide a 2” Carlon Water Meter to meter the make-up water to the boiler feed system and the vacuum condensate pump.

2.6 TEST EQUIPMENT

A. The chemical treatment contractor shall provide the following:

1. Test cabinet to hold test kits.
2. Test kits for alkalinity, sulfite, pH, hardness, conductivity meter.

2.7 STEAM/CONDENSATE SYSTEM

A. General:

1. Before beginning any internal cleaning procedure, make suitable safety garments available to each person participating in the cleaning procedure. All personnel shall be familiar with the cleaning procedure and the safety procedures for handling the chemicals involved.

B. Cleaning - Boil Out:

1. After the installation of your boiler has been completed, and before any operation is begun it is required to clean the water side surfaces of the boiler and the piping system to which the boiler is connected.
2. The piping system may contain oil, grease, welding slag, thread cuttings and other contaminates that should not be left in the system piping. If left in the piping, it is only a matter of time before it will find its way to the boiler. Slag and thread cuttings can block or damage gaskets, valves and control devices.
3. A new boiler is likely to have oil, grease, or other protective coatings that were on the metal parts during the manufacturing process. These contaminants mL5t be removed prior to beginning operation since anyone of them may cause priming, foaming, inefficient heat transfer or contamination of the process to which the steam is directed.

C. Steam Boilers:

1. Close all external valves, such as feedwater, steam supply, chemical feed, and blowdown to avoid loss of chemical and to isolate the boiler internal parts.
2. Remove the safety valves.
3. Remove the manway cover, if so supplied and if it is in the uppermost part of the shell.
4. Fill boiler with fresh water to a level 2-3 inches above the top of the top row of tubes. Just basic tap water is acceptable for this filling.
5. Determine how many gallons of water the boiler will contain when complete Iy filled.
6. Mix Tri-sodium phosphate and caustic soda (Sodium Hydroxide) in the amount of one (1) pound of each for each 100 gallons of water content in the boiler. Add the chemicals slowly into a bucket or barrel with water as necessary to dissolve them. Stir constantly to be sure that the chemicals are thoroughly dissolved.
7. Add the dissolved chemicals carefully through the largest opening available in the top of the boiler.
8. Complete filling of the boiler to the top.
9. Begin firing the boiler at the lowest rate possible and intermittently, as necessary to get the water temperature just above 200 degrees F. During this early firing, the water volume will swell and tend to overflow the openings in the top, so operate the bottom blowdown as necessary to maintain flooded condition in the vessel while minimizing overflow.
10. Continue this low heat input for a minimum of 4 hours, and shut the burner off.
11. Allow boiler water to cool to a temperature of 120 degrees F or less, and drain to a point of safe discharge.
12. Remove all handhole plates or other inspection openings and wash the interior thoroughly with high pressure water. On large boilers, a fire hose is recommended.
13. lf interior surfaces are not clean, you may repeat the above procedure.
14. lf you determine the water side to be adequately clean, proceed to replace the safety valves, re-close the hand hole and manhole plates with new gaskets, and refill the boiler with treated water from your feedwater system. (Additional information about treatment of boiler water is in another section of this manual)
15. When filled to the normal level, the boiler should be checked for leaks and may be fired normally. Allow the trapped air to escape the boiler during this initial filling.

D. Piping:

1. Isolate and clean steam and steam condensate piping systems.

2.8 HOT WATER TREATMENT SYSTEM

A. Closed Recirculating Water Systems (Less than 20,000 gallons).

1. Provide and install equipment for manual addition of chemical treatment and removal of suspended solids for each closed recirculating water system. Equipment shall consist of the following components:

a. Make-up Water Meter shall be cold water oscillating type rated for industrial use. Meter shall be of bronze construction with NPT union connections, standard register totalizing in gallons, maximum pressure rating of 150 psi, and maximum temperature rating of 110°F. Water Meter shall be installed in the make-up water piping to the system fitted with a three (3) valve by-pass.

b. By-Pass Feeder shall be five (5) gallon capacity, steel construction with maximum operating pressure of 300 psi at 200ºF. By-pass feeder shall have 4" wide opening with cast iron, course thread, quick opening top closure, demountable leg extensions, and 3/4" NPT inlet, outlet and drain fittings. By-pass feeder shall be installed across the common discharge and suction piping of the recirculating pumps.

c. Cartridge Filter Vessel shall be 304 stainless steel construction with maximum operating pressure of 150 psi at 250ºF. Filter vessel shall be split shell construction with 1-1/4" NPT inlet, outlet, bottom drain, and top vent fittings. Filter vessel shall be installed across the common discharge and suction piping of the recirculating pumps and shall be sized to filter the equivalent of the system water volume once every four (4) hours.

d. Filter cartridges shall be wound polypropylene media with a tin core, ten (10) micron rating, and a maximum temperature of 200º F sized to properly fit the filter vessel. Filter cartridges shall be furnished in a quantity sufficient for six (6) complete changes of the filter vessel. Filter cartridges shall be changed when the pressure drop across the filter vessel exceeds 20 psi, or as recommended by the water treatment contractor.

e. Corrosion coupon rack shall be preassembled, constructed of 1" NPT carbon steel pipe. Rack shall have four (4) 1" FPT openings for the mounting of corrosion test coupons and shall include a Flow Control for continuous flow regulation. Racks shall be installed between system supply and return piping.

2.9 CHEMICALS

A. Refill all existing systems to the chemical concentration prior to construction.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine the type of water treatment and quantities of chemical treatment needed to maintain acceptable water quality

3.2 INSTALLATION

A. Install water treatment equipment level and plumb. Maintain manufacturers recommended clearances. Arrange units so that controls and devices requiring servicing are accessible.

B. All cleaning, flushing and chemical treatment shall be observed by the chemical treatment representative.

C. Refill all existing systems to the chemical concentration prior to construction.

D. Contractor shall drain, flush, fill, and vent piping systems.

3.3 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Confirm applicable electrical requirements for connecting electrical equipment. Power and control and interlock wiring materials and labor.

3.4 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components and equipment installation, including piping. Report results in writing.

C. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before initiating water-treatment system.

D. Prior to acceptance by the owner, all grease, dirt, oil and metallic oxides shall be removed from each closed recirculating water system. Mechanical contractor shall inform the water treatment contractor of all the system materials of construction to insure chemical cleaner compatibility. Supervision and cleaner shall be provided by Chemical Treatment Company. The following cleaning procedure shall apply:

E. Closed Recirculating Water Systems Cleaning

1. The system shall be filled through a suitable water meter to determine total water volume, taking care to bleed all air.
2. With the system circulating, flow will be verified throughout the system. All debris shall be flushed from the system and all strainers cleaned.
3. H-O-H Water Technology C-312 Multi-Purpose Cleaner shall be added to the system at a dosage rate of twenty (20) gallons per one thousand (1,000) gallons of system volume. The chemical treatment contractor shall verify cleaner strength.
4. Hot water systems shall be heated to 160-180ºF and circulated for twenty-four (24) hours.
5. During the cleaning period, system water shall be circulated through the entire system. Mechanical contractor shall insure that all small orifices (control valves, strainers, etc.) remain free of debris. A side stream filter shall be used for removal of suspended solids during the cleaning period. Filter Media shall be changed as required.
6. When cleaning period is complete, the system shall be drained and flushed with fresh water to remove the cleaning solution. Flushing shall continue until the total (M) alkalinity of the system water is within fifty (50) ppm of the total alkalinity of the make-up water.
7. All strainers, dead legs, and areas of low flow shall be thoroughly flushed to remove accumulated debris.
8. Immediately following completion and verification of flushing, certification records covering the cleaning shall be submitted to the mechanical contractor and the owner. Records shall include system volume, cleaner concentration, circulation time, and final alkalinity reading. Each system shall be chemically treated as provided elsewhere in this specification.

F. Place water-treatment system into operation during the preliminary phase of systems' startup procedures.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-treatment systems and equipment.

B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Operation and Maintenance Data."

D. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 232500

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Insulated flexible ducts.
3. Ductwork fabrication.
4. Single wall spiral round ducts.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
10. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications and sizes in plain view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire rated and other walls.
7. Terminal unit and coil installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Product Data: Submit data for duct materials and duct liner.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

E. Manufacturer's Installation Instructions: Submit special procedures for glass fiber ducts.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

C. Maintain temperatures during and after installation of duct sealant.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of in conformance with ASTM A90.

B. Aluminum Sheets: Comply with ASTM B209 alloy 3003-414, with mill finish for concealed ducts, and standard, one-sided bright finish for duct surfaces exposed to view.

C. Stainless Steel Ducts: Minimum 18 gauge, 316 stainless steel with welded seams. The installation shall conform to SMACNA round industrial duct construction standards for duct supports and reinforcement using stainless steel material.

2.2 MANUFACTURED DUCTWORK

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Insulated Flexible Ducts:

1. Manufacturers:

a. Flex-Master.
b. Therma Flex.
c. Techna Flex.

2. Underwriters Laboratory Standard 181; Class 1.
3. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
4. Pressure Rating: 10 inches w.g. positive and 1.0 inches w.g. negative.
5. Maximum Velocity: 4000 fpm.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.4 SINGLE WALL SPIRAL DUCTWORK

A. General:

1. The duct system shall consist of fittings that are factory fitted with a sealing gasket. The spiral duct fitting will seal the duct joints without the use of duct sealer.

B. Materials:

1. Unless otherwise noted, all duct and fittings shall be G-90 galvanized steel in accordance with ASTM A-653 and A-924.

C. Construction:

1. Fittings:

a. All fitting ends shall come factory equipped with a EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet the performance criteria set forth in the manufacturer’s literature. Gasket shall be classified by Underwriter’s Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
b. All fittings shall be furnished with gasket on the outer shell.

c. All fittings ends shall be calibrated to manufacturer's published dimensional tolerance standard.
d. All fitting ends O.D. shall have rolled over edges for added strength and rigidity during installation and shipping.
e. Transitions shall be provided where insulated duct connects to non-insulated, single wall duct. Transitions also act as insulation ends reducing the double wall outer shell diameter to the inner shell diameter.
f. When contract documents require divided flow fittings, only full body fittings will be accepted. Saddle taps are unacceptable.

2. Spiral Duct:

a. Spiral duct shall be calibrated to manufacturer's published dimensional tolerance standard.
b. All spiral duct 12" Dia. and larger shall be corrugated for added strength and rigidity. The duct will be of spiral lockseam construction.
c. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.

3. When gasket or flanges are not acceptable the duct shall be welded construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

E. Use double nuts and lock washers on threaded rod supports.

F. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

G. Connect flexible ducts to metal ducts with draw bands.

H. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

I. Use crimp joints with or without bead for joining round duct sizes 8 inches and smaller with crimp in direction of air flow. Provide flanged joints for duct sizes 10" and larger.

J. Connect terminal units to supply ducts with three foot maximum length of flexible duct. Do not use flexible duct to change direction.

K. Cleaning and Protection:

1. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
2. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
3. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

3.2 SCHEDULES

A. Ductwork Material Schedule

Air System	Material	Pressure Class	Seal Class
Return Ductwork	Galvanized	2”	C
Supply Ductwork	Galvanized	2”	C
Transfer Ducts	Galvanized	1”	-
Relief Ducts	Galvanized	1”	-
MAU Ductwork	Galvanized	2”	C
General Exhaust	Galvanized	2”	C

END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air turning devices.
2. Back-draft dampers.
3. Duct access doors.
4. Flexible duct connections.
5. Duct test holes.
6. Volume control dampers.
7. Dynamic fire dampers.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
2. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
3. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.

C. Product Data: Submit data for shop fabricated assemblies and hardware used.

D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.

1. Fire dampers including locations and ratings.
2. Backdraft dampers.
3. Flexible duct connections.
4. Volume control dampers.
5. Duct access doors.

E. Product Data: For fire dampers submit the following:

1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
2. Indicate materials, construction, dimensions, and installation details.
3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

F. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of access doors.

C. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.5 QUALITY ASSURANCE

A. Dampers tested, rated and labeled in accordance with the latest UL requirements.

B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect dampers from damage to operating linkages and blades.

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

D. Storage: Store materials in a dry area indoor, protected from damage.

E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each size and type of fusible link.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 AIR TURNING DEVICES

A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS

A. Manufacturers:

1. Greenheck.
2. Cook.
3. Ruskin.
4. Dowco Products
5. Carnes
6. Vent Products.
7. Pottorff.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Manufacturers:

1. Ruskin.
2. Cesco Products.
3. Carnes.
4. Vent products.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

1. Less than 12 Inches Square: Secure with sash locks.
2. Up to 18 Inches Square: Provide two hinges and two sash locks.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Pressure rating of access doors shall match the rating of the system in which they are installed.

2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inch wide, 24 gage galvanized steel.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Ruskin.
2. Vent Products.
3. Dowco Products.
4. Air Balance Inc.
5. Pottorff.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inches. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

F. Remote Operator: Provide Young Regulator or equal, remote operator where damper access cannot be attained through ceiling access door. Operator to be by cable through 7/18" diameter paintable cold rolled steel cover plate concealing socket wrench operated rack and pinion gear drive. Damper shall be complete with similar gear drive smoothly to operate damper through full range of motion from tight shut-off to wide open.

2.7 DYNAMIC FIRE DAMPERS

A. Manufacturers:

1. Ruskin.
2. Vent Products.
3. Dowco Products.
4. Air Balance, Inc.
5. Cesco Products.
6. Pottorff.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations, closure under air flow conditions. Configure with blades our of air stream except for pressure class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 160 degrees F. with adjustable link straps for combination fire/balancing dampers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, fire and smoke dampers, and elsewhere as indicated. Provide minimum 18 x 18 inch size for shoulder access or 2 inches smaller than duct size, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install fire dampers in accordance with NFPA 92A.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

K. The material of the duct accessories shall match the material of the system in which they are installed.

END OF SECTION 233300

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exhaust fans.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for resilient mountings and snubbers for fans for placement by this section.
3. Section 23 07 00 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
4. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for control components to interface with fans.
5. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
6. Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
7. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
8. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. American Refrigeration Institute:

1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Underwriters Laboratories Inc.:

1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish one year manufacturer’s warranty for fans.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one set of belts for each fan.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 UPBLAST BELT DRIVE ROOF EXHAUST FANS

A. Manufacturers:

1. Greenheck.
2. Cook.
3. Carnes.

B. General Description:

1. Upblast fan shall be for roof mounted applications.
2. Performance as scheduled.
3. Each fan shall bear a permanently affixed manufacturer’s engraved metal nameplate containing the model number and individual serial number.

C. Wheel:

1. Constructed of aluminum with non-overloading, backward inclined centrifugal configuration.
2. Statically and dynamically balanced in accordance to AMCA Standard 204-05.
3. The wheel cone and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Motors:

1. Motor Enclosures: Totally enclosed fan cooled, as noted in the exhaust fan schedule.
2. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase.
3. Mounted on vibration isolators, out of the airstream.
4. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.
5. Accessible for maintenance through the motor cover.

E. Shafts and Bearings:

1. Fan shaft shall be ground and polished solid steel with anti-corrosive coating.
2. Permanently sealed bearings or pillow block ball bearings.
3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours, at maximum cataloged operating speed.
4. Bearings are 100 percent factory tested.
5. Fan shaft first critical speed is at least 25 percent over maximum operating speed.

F. Housing:

1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum.
2. Shroud shall have a integral rolled bead for extra strength.
3. Shroud shall be drawn from a disc and direct air downward.
4. Lower windband shall have a formed edge for added strength.
5. All housing components shall have final thickness equal to or greater then performed thickness.
6. Curb cap shall have pre-punched mounting holes to ensure correct attachment.
7. Rigid internal support structure.
8. The housing shall be leak proof and weatherproof.

G. Housing Supports and Drive Frame:

1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

H. Vibration Isolation:

1. Double studded or pedestal mount true isolators.
2. No metal to metal contact.
3. Sized to match the weight of each fan.

I. Drive Assembly:

1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. The motor pulley shall be adjustable for final system balancing.
5. Readily accessible for maintenance.

J. Accessories:

1. Disconnect switch.
2. Auto belt tensioner.
3. Birdscreen:

   a. Aluminum construction.
   b. Protects fan discharge.

4. Roof Curbs: See hangers and supports specification section 23 05 29.
5. Motorized backdraft damper, wired by BAS contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with stainless steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to opening.

D. Provide sheaves required for final air balance.

E. Install backdraft dampers on inlet to roof exhausters.

F. Install flexible connections between fan inlet and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

G. Install fans as indicated, with flexible electrical leads.

H. Pipe housing drain to nearest drain.

END OF SECTION 233400

SECTION 233700 - AIR OUTLET AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers.
2. Registers
3. Grilles.
4. Louvers.
5. Roof hoods.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
2. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Test Reports: Rating of air outlet and inlet performance.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

1.6 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Titus.

B. Carnes.

C. Price.

D. Nailor.

E. Acutherm.

F. Krueger.

2.2 ADJUSTABLE CURVED BLADE DIFFUSERS

A. Diffuser shall have curved deflectors, which are individually adjustable from the face of diffuser to regulate air volume and angle of discharge.

B. Diffusers shall be built in one-, two-, three-, or four-way discharge patterns.

C. The diffusers shall be constructed of 20 gauge steel or 0.051 aluminum with miscellaneous steel components, depending on the model selected.

D. The finish shall be #26 white, acrylic paint, baked at 315°F for 30 minutes.

E. Optional opposed blade damper shall be constructed of heavy gauge steel and shall be installed on the neck of the diffuser. Damper must be operable from the face of the diffuser.

2.3 PLAQUE CEILING DIFFUSERS

A. Type: Square, plaque, air deflector to discharge air in 360 degree pattern.

B. Frame: To match ceiling type.

C. Fabrication: Steel with baked enamel finish as selected by Architect.

D. Accessories: Redial opposed blade damper.

2.4 HEAVY DUTY RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/8 inch maximum spacing with 38° deflection.

B. Frame: 1 1/4 inch margin with countersunk screw and gasket mounting.

C. Fabrication: Steel with 16 gage minimum frames and 14 gage minimum blades and corners securely fastened to be immobile.

2.5 CEILING EXHAUST AND RETURN REGISTERS

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 35 degrees, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, aluminum or steel with 20 gage minimum frame, with factory off-white enamel finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.6 SUPPLY GRILLES AND REGISTERS

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with adjustable blades, horizontal face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades. Steel and aluminum with 20 gage minimum frame, or Aluminum extrusions, with factory clear lacquer finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.7 LOUVERS

A. Manufacturers:

1. Ruskin.
2. American Warming.
3. Vent Products.
4. Pottorff.

B. Type: 6 inch deep extruded aluminum storm resistant fixed horizontal louver with drainable blades on 37 1/2 degree slope with center baffle and return bend, heavy channel frame, downspouts, birdscreen with 1/2 inch expandable aluminum mesh.

C. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory anodized finish color to be selected by architect.

D. Mounting: Channel frame with drip cap and extended sill, no flange unless directed by architect.

2.8 ROOF HOODS

A. Manufacturers:

1. Cook.
2. Greenheck.
3. Carnes.

B. Fabricate air inlet or exhaust hoods in accordance with SMACNA HVAC Duct Construction Standards.

C. Fabricate of aluminum, minimum 16 gauge base and 18 gauge hood; suitably reinforced; with removable hood; birdscreen with 2 inch square mesh for exhaust and 3/4 inch for intake, and factory baked enamel finish. Color of hood shall be selected by the architect.

D. Mount unit on minimum 18 inch high curb base with insulation between duct and curb.

E. Make hood outlet area minimum of twice throat area.

F. Refer to drawings for type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify inlet and outlet locations.

3.2 INSTALLATION

A. Install diffusers to ductwork with airtight connection.

B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION 233700

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Double wall metal stacks.
2. Double wall gas vents.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.66 - Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
2. ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Device.
3. ANSI Z21.68 - Thematically Actuated Automatic Vent Damper Devices.

B. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
5. ASTM C401 - Standard Classification of Alumina and Alumina-Silicate Castable Refractories.
6. ASTM A 959 – Type AL29-4C Vent

C. National Fire Protection Association:

1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
2. NFPA 54 - National Fuel Gas Code.
3. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment.
4. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - Guide for Steel Stack Construction.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
2. UL 127 - Factory-Built Fireplaces.
3. UL 378 - Draft Equipment.
4. UL 441 - Gas Vents.
5. UL 641 - Type L Low-Temperature Venting Systems.
6. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.3 DEFINITIONS

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: Portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: Part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittals procedures.

B. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breeching. Submit layout drawings indicating plan view and elevations.

C. Product Data: Submit data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

D. Natural draft appliances complying with NFPA 211 and UL listed and labeled.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain water integrity of roof during and after installation of chimney or vent.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 DOUBLE WALL METAL STACK

A. Manufacturers:

1. Selkirk - Metalbestos.
2. Ampco.
3. Metalfab.
4. Van Packer
5. Schebler.

B. Provide double wall positive pressure type metal stacks, tested to UL 103, and UL 641, for use with building heating equipment, in compliance with NFPA 211.

C. Fabricate with 1 inch minimum air space between walls. Construct inner jacket of 20 gage ASTM A167 Type 304 stainless steel. Construct outer jacket within the building of aluminum coated steel and outside the building of Type 304 stainless steel outer jacket to be 24 gage for sizes 10 inches to 24 inches and 20 gage for sizes 28 inches to 48 inches.

D. Accessories, UL labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
2. Stack Cap: Consists of conical rain shield with inverted cone for partial rain protection with low flow resistance.

2.2 TYPE B DOUBLE WALL GAS VENTS (For Use With Domestic Water Heaters)

A. Manufacturers:

1. Selkirk - Metalbestos.
2. Ampco.
3. Metalfab.
4. Van Packer.
5. Schebler.

B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

C. Barometric Dampers: Same size as flue collar constructed of stainless steel or galvanized steel, with corrosion-resistant components, and including counterweight.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 INSTALLATION

A. Install in accordance with NFPA 54, NFPA 31, and SMACNA Guide for Steel Stack Construction.

B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. Support breeching from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breeching, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

D. Pitch breeching with positive slope up from fuel-fired equipment to chimney or stack.

E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement.

F. Level and plumb chimney and stacks.

G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.

H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

I. Provide all stainless steel supports, guy wires, turnbuckles, etc. above the roof as required.

END OF SECTION 235100

SECTION 235239 - STEAM FIRE-TUBE BOILER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled boilers, trim, and accessories for generating steam 15 PSIG and under with the following configurations and burners:

1. Horizontal, fire-tube/fire-box boiler.
2. Gas burner.
3. Instrumentation and control panel.
4. Combustion controls.
5. Fuel gas system.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
2. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for natural gas piping connections to boilers specified in this section.
3. Section 23 21 13 - Hydronic and Fuel Piping: Execution requirements for hot water piping for piping connections to boilers specified in this section.
4. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for steam piping for piping connections to boilers specified in this section.
5. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
6. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.2 SUBMITTALS

A. Submit manufacturer’s data; include performance data, emission certifications for noise levels on forced draft burner, turndown performance on forced draft burner, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include elevations, details, access clearances, and attachments to other work. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

F. Other Informational Submittals:

1. Startup Reports: Submit reports documenting the activities required to be performed in Part 3. These reports are to be submitted two weeks after the startup is completed. Reports on startup shall be the responsibility of the installing contractor in coordination with a factory-authorized service representative.
2. Training Reports: Submit reports on training documenting dates and attendance. Training reports shall be the responsibility of the installing contractor.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Provide firetube boiler ancillary electrical components which have been listed and labeled by UL.

C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code Section IV (15 PSIG Steam).

D. The boiler pressure vessels shall have ASME Stamp.

E. Installing contractors shall be Hartford and National Board certified.

F. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide per manufacturers recommendations.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements.

1.6 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of boiler that fail in materials or workmanship within specified warranty period. Provide warranty on materials and labor for two year from date of preliminary acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Fire Tube/Fire Box Boiler

   a. Hurst Boiler & Welding Company, Inc.
   b. Johnston Boiler Company.
   c. Cleaver-Brooks.

2. Forced Draft Burner

   a. Riello RS-E/V.

3. Burner Management Controls

   a. Siemens LMV.

2.2 HORIZONTAL FIRE TUBE BOILER

A. Description: Factory-fabricated, assembled, and tested, horizontal, fire-tube boiler with not less than 4.5 total square feet of fireside heating surface, heat exchanger sealed pressure tight, built on a steel base; including insulated jacket, flue-gas vent, water supply and return connections, and controls. Unit to be ready for automatic operation except for connection of steam, feed water supply and return, fuel, electrical, chemical, vent and drain and blowdown. The boiler shall be of the compact design capable of fitting through a standard 72" x 80" doorway opening with the trim and controls removed. All specified boiler trim, burner controls and fuel train must be factory pre-piped, wired and assembled before shipment. If items are required to be removed for installation, this must be performed in the field by the installing mechanical contractor.

B. Pressure Vessel Design: Straight, steel tubes rolled into steel headers, welded tubes shall not be acceptable. Three passes with full wet-back design (dry back designs are not acceptable). Construct to ASME Boiler and Pressure Vessel Code Section IV for 15 psig steam. Boiler shell constructed of not less than 5/16" (0.3125") thick boilerplate for boiler less than 80 HP and not less than 3/8" (0.375") thick boilerplate for boilers larger than 100 HP. Tube sheets constructed of not less than 1/2" (0.50") thick boiler plate. Twin tube sheets used in the rear turnaround. Top and sides water cooled with poured rear door (end only). The boiler shall have sufficient steam release surface and steam dome to assure 99.5% steam quality. Include the following accessories:

1. Tube Size and Thickness: Minimum NPS 2" OD, minimum 13 gauge thick for boilers less than 80 HP and Minimum NPS 3" OD, minimum 13 gauge thick for boilers larger than 100 HP..
2. Cleanout openings.
3. Lifting lugs on top of boiler.
4. Minimum NPS 1" hose-end drain valves at shell low point.
5. Accessible drain and blowdown tapings, both high and low, for surface and mud removal.
6. Tapping's for steam supply, makeup, level controls, and chemical treatment.
7. Provide a baffle in the boiler shell below the main steam outlet flange to provide for dry steam with no water carry over. Provide a baffle at the feedwater inlet to temper the water.

C. Front and Rear Doors:

1. Flanged, bolt on type front and rear smoke boxes insulated with ½" thick millboard. Removable, sealed with heat-resistant gaskets and fastened with lugs and cap screws.
2. Designed so tube sheets and flues are fully accessible for inspection or cleaning when doors are open. Front smoke box access plate constructed of 0.25" plate with handles for easy removal. All bolts and studs shall have brass nuts.
3. Include 2" Pyrex observation port in rear door of boiler for inspection of flame conditions.
4. Door insulation shall be accessible for inspection and maintenance.
5. Rear smoke box fitted with stack outlet and flanged to boiler with bolted clean out.

D. Casing:

1. Insulation: Minimum 2-inch-thick, readily removable mineral-fiber insulation surrounding the boiler shell (or as required to maintain a maximum allowable radiation heat loss at peak firing rate of 2% of peak input) covered by a sectional sheet metal jacket. Maximum surface temperature at full fire shall not exceed 140°F.
2. Flue Connection: The flue connection shall include a locking blade damper and a stack thermometer to be shipped loose.
3. Jacket: The boiler shall be lagged with a 22 gauge thick carbon steel jacket and painted with industrial grade epoxy enamel protective finish.
4. Mounting base minimum 8" skids to secure boiler to concrete base.
5. Control Compartment Enclosure: NEMA Type.

E. Barometric Damper: Galvanized-steel assemblies with flue-gas thermometer.

2.3 FORCED DRAFT BURNER

A. Burner: forced draft, high efficiency, low NOx, full modulating, welded construction with multi-vane, stainless-steel, combustion head for natural gas (1000 BTU/CF). Minimum 10:1 turndown. Boiler/burner combustion efficiency shall exceed ASHRAE 90.1-1999. Burner shall be equipped with hinged head mount that allows full access to the burner drawer assembly without removing the burner chassis from the boiler.

B. Blower: Energy efficient, self-cleaning, reverse inclined fan blade type, directly driven by variable frequency premium efficient motor; with adjustable, dual-blade damper assembly and locking quadrant to set air-fuel ratio.

1. Motor Size: High efficiency, totally enclosed fan cooled motor (TEFC) and a dynamically balanced blower wheel. Minimum size as indicated. If not indicated, large enough so driven load shall not require motor to operate in service factor range above 1.0.
2. Motor: Provide variable frequency drive.

C. Gas Train: Control devices and modulating control sequence shall comply with requirements in ASME CSD-1, UL, and FM. Provide Siemens gas shutoff valves and manual shutoff valves.

D. Pilot gas train to include solenoid shutoff valve and manual ball type shutoff valves.

E. Gas pressure available at gas train inlet 5 PSIG.

F. Provide gas pressure regulator as required to step down building gas pressure to maximum gas train inlet pressure.

G. Pilot: Interrupted-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.

H. Tight shut off air inlet louver box.

I. Burner shall be certified by manufacturer in writing to operate under 85 dBa across full range of fire, when measured at 3 feet from the burner. Burner inlet silencer shall be furnished if required by manufacturer to meet 85 dBa across full range of fire.

J. The burner must be outfitted with a linkageless fuel/air metering system. The fuel/air drive shall not contain any linkage cam assembly with the flame safeguard system. The system shall be capable of providing an adjustable and accurately repeatable constant fuel/air ratio of an adjusted fuel/air ratio throughout the burner's firing range through the programming of independent servomotors. Each servomotor shall be capable of 177 in-lb. torque with 90 independently programmable set-points. The burner shall have automatic modulation from a separate electronic pressure transducer. Provide in boiler control panel a local/remote switch for remote set point control by BAS when in the remote position. BAS shall never maintain firing rate control of boiler.

K. Burner shall be equipped with a complete system of safety devices, including the electronic flame safeguard control with pre and post purge and UV flame detection. Pre-purge shall be a full open purge of sufficient time to provide four air change ignition purges of the combustion chamber or full 30 second duration pre-purge. All controls shall be approved by UL.

L. Burner shall burn the specified quantity of gas fuel without objectionable vibrations, noise or pulsation, with not more than 20% excess air in the products of combustion, the exhaust gases as measured in the flue outlet of the boiler shall not exceed 4% O2 levels from 20% to 100% of the firing rate as determined by a combustion analyzer for maximum combustion efficiency.

M. Interlock control requirements

1. The burner manufacturer shall furnish all required control interlocks between the boiler-burner and related equipment as herein specified and as follows:

a. Contacts as required for all remote alarms.
b. Relays for remote boiler room combustion air dampers.
c. Contacts for remote enable/disable of boiler-burner

2.4 STEAM BOILER TRIM

A. Pressure Controllers (Honeywell or Siemens):

1. Auto reset type shall control burner on-off to maintain steam pressure operating gauge,
2. Modulating type electronic pressure transducer shall control burner firing rate to maintain steam pressure setting and
3. Manual reset type shall control burner to prevent steam pressure from exceeding safe system pressure.
4. Low fire hold temperature sensor.

B. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code. Two (2) full sized relief valves are required for each boiler.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.

C. Pressure Gauge: Minimum 6-inch diameter. Gauge shall have normal operating pressure about 50 percent of full range.

D. Automatic surface blowdown system complete with integral perforated skimmer, metering valve and shut off valve.

E. Water Column: Gauge glass set to be the standard gauge glass assembly as furnished with the McDonnell Miller operating level controller. Minimum 12-inch glass gauge with shutoff cocks.

F. Try cocks on the water column.

G. Low water cutoff and feed water pump control.

H. Auxiliary low water cutoff to be McDonnell-Miller 750-MT-120 Probe Type (rated at 250 psig).

I. Boiler water column to be McDonnell Miller No. 157S (rated at 150 psig).

J. Stop Valves: Boiler inlets and outlets, except safety relief valves or preheater inlet and outlet shall be equipped with stop valve in accessible location as near as practical to boiler nozzle and same size as or larger than nozzle. Valves shall have rising stem.

K. Stack Damper: Motorized stack damper actuator mounted and wired.

L. Stack Thermometer: 5-inch diameter flue gas temperature gauge (100-600°F). 1% full scale accuracy.

2.5 BOILER/BURNER CONTROLS

A. The burner vendor shall provide factory-assembled and wired control panel to contain all required digital, electronic, hard wire relays, terminals, switches, indicating lights, etc. securely and conveniently mounted on the boiler/burner. All field wiring connections shall be clearly labeled on submittal information.

B. The boiler/burner controls shall be UL listed and labeled and in conformance with ASME CSD-1.

C. Relays and connections for operation of a combustion air damper and remote boiler trouble alarm.

D. Alarm horn with silencing pushbutton mounted on the burner control panel and arranged to sound on all non-recycling boiler shutdown conditions.

E. The burner management system shall be Siemens LMV. Honeywell Controllinks and Fireye PPC/Nexus shall not be acceptable.

1. No momentary power loss, voltage or frequency loss shall cause the burner management system to shut down requiring manual reset.
2. The burner management system shall have the capability of receiving a 0 – 10 VDC, 4 – 20 mA signal directly from the boiler pressure controller without the use of an external signal converter for natural gas operation.
3. The burner management system shall be capable of generating an output signal based on any of the above mentioned input signals with the exception of position proportioning.
4. When the operating control is satisfied the burner shall shut off and return to the closed position. The modulating servomotor shall provide an electrical interlock to ensure a guaranteed low fire start.

F. Burner Control Panel

1. Factory pre-wired control panel shall be supplied with boiler-burner unit. The panel shall be mounted on the boiler. The burner panel shall meet NEMA compliance. The flame safeguard shall be a Siemens LMV, complete with a through the panel door, view window. The flame safeguard system shall include an AZL expansion module to monitor the status of all safeties on the boiler. The expansion module shall monitor the status of the following inputs: primary and secondary low water cutouts, operating control, pilot flame failure, low air switch, low gas pressure, high gas pressure, main fuel failure, failure of air servomotor controller, failure of fuel servomotor controller. The panel shall contain a main start switch, set point adjustment, operating pressure control (factory wired and mounted to cycle burner, burner motor starter with overloads, control transformer, fuses, control switch and indicating lights as specified. Each panel shall have five indicating lights: Power On, Ignition, Main Fuel, Call for Heat, Alarm. Provide an alarm horn with automatic reset silencing mechanism, to ring on flame failure, low water, or limit failure. Shut down due to high steam pressure, flame failure, pilot failure, or low water shall require manual reset. The burner panel shall include an individual 7” color touchscreen separate from the AZL at which digital discrete inputs shall be capable of monitoring and adjustment by operator. The 7” color touchscreen shall be mounted such that the operator shall have free access without removal or opening of any additional devices. The basis for this design shall be the Riello Boiler Wizard Jr. All wiring to be number coded at every termination. Wiring diagrams shall clearly indicate wiring numbers and termination points. Liquid tight wiring shall be used throughout. Provide terminal position for a remote alarm annunciation through Modbus.

2. Provide an oxygen trim control system for each boiler, integrated with the burner controls to trim the combustion process of the burner to maintain 3% excess oxygen content in the boiler flue gases. Oxygen trim system shall be Siemens PLL52 for interface with Siemens LMV.
3. Separate factory installed terminal strip dedicated for interface to EMS (Energy Management System via LON) for monitoring points. Points required – control power to open combustion air damper, boiler enable/disable, boiler status, burner firing rate position, main gas valve position, air damper position, steam pressure set point, steam pressure positive variable, stack temperature, ambient air temperature, cold start enable temperature, exhaust oxygen content, and boiler efficiency.
4. Factory installed panel mounted Local/Remote switch to select burner enable/disable (not modulation) from either internal boiler controls or (not of) EMS.
5. Low-Water Cutoff and Pump Control: Operate feed water pump(s) cycle feed water pump(s) for makeup water control.
6. Sequence of Operation: Electronic, factory-fabricated and factory-installed panel to control burner firing rate to maintain a constant steam pressure. Maintain pressure set point plus or minus 1 percent.
7. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

    a. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design pressure.
    b. Low-Water Cutoff Switch (UL, CSD-1): Float type with snap action, electronic type shall not be acceptable, shall prevent burner operation on low water. Low cutoff switch shall be manual-reset type
    c. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

8. Common Alarm output to signal the EMS when any safety or condition shuts down the boiler.
9. Low fire hold control with minimum temperature standby control and standby-operate switch.
10. Power disconnect switch installed in the burner control panel.
11. All terminals shall be uniquely identified with an alpha numeric sequence.
12. All wires shall be uniquely identified with an alpha numeric sequence.
13. A clear distinction shall be made of wiring to non-boiler vendor devices in the submittal information.
14. Burner manufacturer provided Boiler Wizard Lead/Lag Boiler System Control. Boiler Wizard Lead/Lag System shall monitor Flue and supply gas temperatures, flue gas oxygen content, boiler set point, boiler positive variable, boiler firing rate, burner fuel servomotor position, burner air servomotor position, burner blower motor variable frequency position and calculate boiler efficiency. Boiler Wizard system shall have LON communication gateway for BMS interface. Boiler Wizard shall trend all values including alarm annunciation for the past 365 days. Boiler Wizard shall include either remote local intranet or Internet accessibility for monitoring of above functions. Boiler Wizard system shall auto-rotate boilers and allow for lag boiler timed warm-up with night and weekend set-back functions.

2.6 BOILER BLOWDOWN SYSTEM AND CONTROL

A. Provide Boiler Surface Blowdown System with skimmer tube and bushing, conductivity sensor probe, motorized metering control valve with NEMA 4 actuator and electronic control panel. Factory mount and wire valve and probe on boiler and ship panel loose for field installation.

B. Provide Manual Boiler Blowdown System as manufactured by Hurst Boiler and Welding Company or owner approved equal. Blowdown Separator sized for boiler with a design pressure of 15 PSIG and 2-Inch boiler blowdown. The Blowdown Separator shall be ASME stamped and registered with the National Board of Pressure Vessel Inspectors and rated for 250 PSIG.

1. The blowdown separator shall be 14-Inch in diameter x 54-Inch in height and have 16-Inch supports (70-Inch Overall Height) for floor mounting.
2. The inlet connections shall be 2-Inch, the vent size shall be 6-Inch and the drain size shall be 6-Inch.
3. Separator Trim: 6-Inch Aftercooler that allows the cold water to mix with the blowdown water.
4. Temperature Regulator: self-modulating control valve that is temperature actuated, self-powered and applicable to cooling processes using water.
5. Stainless steel vibration resistant and moisture proof dial thermometer.
6. Strainer with tapered bushing and bolted cover and furnished standard with a NPT blow-off connection.
7. Check Valve: spring loaded type.

2.7 ELECTRICAL POWER

A. All power supply to the panel shall be 460 volt, 3 phase, 60 hertz. All control supply to the panel shall be 120 volt single phase, 60 hertz and come from an integral step-down transformer mounted in the burner panel. Burner motors shall be of capacity as required.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base, at the same elevation.

B. Vibration Isolation: Elastomeric isolator pads with a minimum static deflection of 0.25 inch.

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim as required to be responsibility of the installing contractor.

E. Install electrical devices furnished with boiler/burner but not specified to be factory mounted; installation of electrical devices not factory mounted to be the responsibility of the BAS contractor.

F. Install control wiring to field-mounted electrical devices, to be the responsibility of the BAS contractor.

3.3 CONNECTIONS

A. Install piping adjacent to boiler to allow service and maintenance.

B. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

C. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tapings with shutoff valve and union or flange at each connection.

D. Install piping from safety valves with proper pipe supports to terminate 7'-0" above the roof.

E. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

F. Connect breeching full size to boiler outlet.

3.4 PRE START-UP - STEAM

A. The following steps shall be attended to at initial startup and after any period of shutdown.

1. Check the Feedwater tank (deaerator) to verify that water level is correct and that feed valve that supplies water to the tank is open.
2. Pump suction valves are open
3. Power is available to the pump(s)
4. Main steam supply valve(s) is open
5. Safety valve(s) is correct for this boiler design for pressure and capacity
6. Boiler water is at correct level and Feedwater valve(s) is open
7. Verify low water cutoff operation by opening water column blowdown valve until alarm sounds and feed pump starts
8. Verify that Auxiliary Low Water Cutoff is operational. (You may close feed valve and open bottom blowdown for this check. Be sure to re-open feed valve after you close blowdown valve.) Pump should start and bring water level in the boiler back to normal operating level
9. Verify water treatment system(s) is operational and valves are open
10. All control cabinets should be clean -inside and out - with completely functional doors that are closed
11. Equipment guards should be in place
12. Fuel valves should not be open at this time

3.5 CONTRACTOR STARTUP AND REPORTING

A. Contractor Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions. On all steam boiler applications, installing contractor shall be required to perform a boil-out of the boiler to be done in strict conformance with manufacturer's requirements. After boil-out of the steam boiler is completed, the installing contractor shall be required to flush out the boiler in strict conformance with the manufacturer's requirements. Installing contractor shall be required to engage an agent of the owner's representative for the boil-out and flushing procedure. Installing contractor shall be required to provide seven days' notice for scheduling agent of owner's representative to be present for boil-out and flushing procedure of the steam boiler. Installing contractor shall present a report documenting proper boil-out and flushing of the system with certification from owner's representative that procedures have been completed satisfactorily to the Owners Specification.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency. Installing contractor shall engage a factory-authorized service representative to perform all burner adjustments.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure. Installing contractor shall engage a factory-authorized service representative to perform all set point adjustments.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Remove and replace malfunctioning units and retest as specified above.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other than normal occupancy hours for this purpose.

D. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.
2. Provide written certification to the Architect and Engineer of Record that the installation conforms to the manufacturer's requirements. Installing contractor shall be required to certify in writing to the Engineer of Record any manufacturer’s requirements that are not adhered to in the installation.
3. Provide an initial burner set-up combustion efficiency report to the Architect and Engineer of Record or Owners Representative. Include in Report:
4. Date
5. Project Name
6. Ambient Temperature
7. Boiler Room Temperature
8. Boiler Room Pressure Compared to Ambient "w.g.
9. Stack Draft at Boiler "w.g.
10. Furnace Draft "w.g.
11. Actual Stack Temperature ºF.
12. %NO, %CO and %O in flue gas.
13. Gas Consumption Clocked From Gas Company Meter.
14. Provide a final burner set-up combustion efficiency report to the Architect and Engineer of Record or Owners Representative. Include in Report:
15. Date
16. Project Name
17. Ambient Temperature
18. Boiler Room Temperature
19. Boiler Room Pressure Compared to Ambient "w.g.
20. Stack Draft at Boiler "w.g.
21. Furnace Draft "w.g.
22. Actual stack Temperature °F.
23. %NO, %CO and %O in flue gas.
24. Gas Consumption Clocked From Gas Company Meter.
25. Provide four hours of instruction to the site personnel.

3.6 FACTORY STARTUP AND REPORTING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Startup service shall include the testing, inspections and startup test reports. A full load shall be required during startup service.

3.7 DEMONSTRATION AND COMMISSIONING

A. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining chillers. The training will occur after the startup report has been provided to the Owner and the trainer shall provide two (2) Installation and Operations manuals for the use of the Owner’s personnel during training.

B. Review data in maintenance manuals. All required and recommended maintenance shall be reviewed as well as operational troubleshooting. Provide a written troubleshooting guide if the IOM does not include one.

C. Schedule training with Owner, with at least seven days' advance notice. Scheduling shall be the responsibility of the installing contractor.

D. Demonstrate proper operation of equipment to commissioning agent or designated Owners personnel. The scope of the demonstration shall include functional performance requirements under both local and building automation control.

END OF SECTION 235239

SECTION 235240 - BOILER OPERATING CONTROL PANEL

PART 1 - GENERAL

1.1 SUMMARY

A. Submit manufacturer's data; include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For operating control panel. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For operating control panel components, and accessories to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

E. Other Informational Submittals:

F. Startup Reports: Submit reports documenting the activities required to be performed in Part 3. These reports are to be submitted two weeks after the startup is completed. Reports on startup shall be the responsibility of the installing contractor in coordination with a factory-authorized service representative.

G. Training Reports: Submit reports on training documenting dates and attendance. Training reports shall be the responsibility of the installing contractor.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of burner that fail in materials or workmanship within specified warranty period. Provide warranty on materials and labor for two years from date of preliminary acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

B. Boiler Operating Control

C. Riello Boiler Wizard

D. Mechtronic Resources, Inc.

2.2 CONTROL PANEL

A. Boiler Operating Control Panel

1. Boiler Wizard touch screen system combined with the Siemens LMV52 provides boiler management and interface to operators building management system. Purpose is to gather information, store it and display it in a meaningful intuitive way or to transmit it to a higher level BMS via LON. In Lead-Lag systems the Boiler Wizard sequences the boilers via initiate commands only. If the communication to the LMV's is interrupted the boiler will control to a failover set point within the Siemens LMV52.
2. The 15" color touch screen provides information to operate and monitor all boiler functions. The Boiler Wizard provides:

    a. Graphical display of all burner functions and data:

        1) Current Burner Phase and Status
        2) Boiler Set Point
        3) Boiler Operating Pressure
        4) Burner Output
        5) Flame Signal
        6) Air and Fuel valve positions
        7) Runtime Counters and Timers

    b. Optional Steam Pressure and Feed Water Temperatures Display
    c. Real-time and Historical trend screens of:

        1) Boiler Set Point, Actual Pressure and % Output
        2) Steam Pressure and Feed Water Temperatures
        3) User configurable threshold alarms to warn of impending problems
        4) User configurable and scalable additional analog inputs (Optional)
        5) On screen history of alarms and faults
        6) E-Mailing of alarms and faults to five separate accounts
        7) Pop-up window of alarm or fault with troubleshooting help
        8) Remote viewing of all Boiler Wizard screens via Intranet or Internet
        9) Multiple password security levels
        10) Night and Weekend Setbacks

3. User Configurable Threshold Alarms:

    a. All Boiler Wizards have user configurable threshold alarms. Values can be set to warn of impending problems before the problem can cause a complete shutdown of the boiler. User configurable alarms include; Flame Signal, Flue Gas Temperature, High and Low O2 Level, Feed Water Rate of Change, High and Low PV. Note: Some alarms require specific hardware options and may not be available on all system configurations.

4. User configurable and scalable additional analog inputs:

    a. With the optional analog input cards the Boiler Wizard can display a variety of process values such as steam flow, gas flow, feed water flow, TDS parameters.

5. Steam Control Valves:

   a. Control set points for system electrically operated pressure reducing steam control valves located in the boiler room. Control downstream pressure based on local set point via pressure transmitter and outdoor reset. Valves shall modulate steam pressure control based on input parameters.

6. "Sweet Spot Tracking":

   a. Usually boiler efficiency is highest somewhere between 50% and 80% of maximum capacity rating. It is generally lower at low load due to higher excess air and higher radiation and convection losses, and lower at high load due to high stack temperature. On systems with the LMV52 oxygen trim option the "Sweet Spot Tracking" feature will track the optimum efficiency operating point of your boiler.

7. Intranet and Internet Monitoring:

   a. The Boiler Wizard can be viewed on Internet Explorer over an Intranet network internal to a building or over the Internet around the world. To use the Internet feature a router address option is available on the Boiler Wizard. Router and firewall settings will be required to allow Internet access.

8. Printing:

   a. All Boiler Wizards have the capability to print screens, trend charts and alarm listings to a variety of printers over a network or from the USB port on the Boiler Wizard touch screen.

9. IP Addressing:

   a. The IP address of the Boiler Wizard can be set manual or can be assigned by a DHCP server. The router IP address can also be set to allow access to the Boiler Wizard over a networked DSL router.

B. Other hardware requirements

C. Control circuit transformer if required.

D. Magnetic contactors rated at 100,000 cycles.

E. Current - limiting fuses rated at 1255 of circuit or device load and 200,000 ampere interrupting capacity.

F. Variable Frequency Drive.

2.3 ELECTRICAL POWER

A. All power supply to the panel shall be 120 volt, single phase.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND COMMISSIONING

A. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining chillers. The training will occur after the startup report has been provided to the Owner and the trainer shall provide two (2) Installation and Operations manuals for the use of the Owner’s personnel during training.

B. Review data in maintenance manuals. All required and recommended maintenance shall be reviewed as well as operational troubleshooting. Provide a written troubleshooting guide if the IOM does not include one.

C. Schedule training with Owner, with at least seven days' advance notice. Scheduling shall be the responsibility of the installing contractor.

D. Demonstrate proper operation of equipment to commissioning agent or designated Owners personnel. The scope of the demonstration shall include functional performance requirements under both local and building automation control.

END OF SECTION 235240

SECTION 235300 - FEEDWATER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Feedwater pumps and receivers.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for connection to pumps specified by this section.
3. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and execution requirements for piping specialties used in steam piping systems.
4. Section 23 52 39 - Fire-Tube Boilers: Boilers serving steam systems.
5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacity, temperature, pump performance curves with selection points clearly indicated, and furnished specialties and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, method of field assembly, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For feedwater equipment to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer’s Preparation for Shipping: Clean flanges and exposed-metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with suitable protective covers or with screwed-in plugs.

B. Store feeedwater equipment unit in dry location.

C. Retain protective flange covers and machined-surface protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.6 WARRANTY

A. Written manufacturer's warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

PART 2 - PRODUCTS

2.1 FEEDWATER UNITS

A. Manufacturers:

1. Subject to compliance with requirements, provide products by one of the following:

a. Mepco Pump Packages.
b. Hurst Boiler & Welding, Inc.
c. Federal Pump Corporation.
d. Vent-Rite Pump Company.

B. Description: Factory-assembled and -tested unit consisting of a receiver, triplex feedwater pump system, controls, and the following features and accessories:

1. Thermometer: 3-Inch stainless steel dial register Fahrenheit.
2. Level gage glass with stops at top and bottom.
3. Lifting eyes.
4. Companion flanges.
5. Pump, suction isolation valve, and wye pattern suction strainer and isolation, discharge spring loaded lift disk check valve, combination balance and shut-off valve, flow sensor and pressure gage.
6. Makeup Water Assembly: Piston pilot operated solenoid valve controlled by tank mounted internal float operated switch; with inlet strainer and three-valve bypass. Sizes as indicated on the drawings.
7. Feedwater Heater: Sparge tube, thermostat, and control valve.
8. High Water Alarm: McDonnell Miller No. 69 high water alarm float switch.
9. Low Water Alarm and Pump Shut-Off: McDonnell Miller No. 69 low water float switch.
10. Tank Corrosion Inhibitor: Magnesium tank anode.
11. Each boiler feed pump discharge shall be supplied with a Keckley Figure 119R diaphragm valve for boiler feedwater control.
12. Factory-Installed (complete suction assembly) Pipe, NPS 2-1/2 (DN 65) and Smaller: ASTM A 53/A 53M, Type S (seamless), Grade B; or ASTM A 106, Type S, Grade B, Schedule 40; with one of the following threaded joints and fittings:

a. Cast-Iron Threaded Fittings: ASME B16.4; Class 125.
b. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150.
c. Forged-Steel Fittings: ASME B16.11, Class 3000.
d. Malleable-Iron Unions: ASME B16.39; Class 150.
e. Forged-Steel Unions: MSS SP-83, Class 3000.

13. Reverse acting float switch with electric solenoid valve, strainer, and approved air gap assembly and three valve bypass.

C. Receiver:

1. Material: Minimum 1/4" thick welded carbon steel.

D. Mounting Frame: Structural-steel floor mounting support for receiver and pumps.

E. Vertical Feedwater Pump: Vertically mounted, close-coupled, bronze fitted, single-stage, enclosed impeller, centrifugal pump; rated for 175-psig minimum working pressure and a continuous water temperature of at least 225 deg F; with the following features:

1. Impeller: Cast Bronze.
2. Seals: Mechanical (225° F rated).
3. Shaft: Stainless Steel
4. Motor: Totally enclosed fan proof enclosure. Comply with requirements in Section 230513 "Motors."
5. Steel pump discharge.

F. Control panel shall be unit mounted and factory wired and include the following:

1. UL Listed NEMA, Type 4X enclosure.
2. Single-point field power interface to non-fused disconnect switch.
3. NEMA rated combination magnetic starter for each motor with circuit breaker and three overload relays.
4. Include a three position hand-off-automatic selector switch with overcurrent protection for each motor.
5. Momentary contact motor test switch
6. Manual pump transfer switch
7. Numbered terminal blocks with color-coded wiring to match wiring diagram.
8. All connections to motor with liquidtight conduit.
9. Removable control mounting plate.
10. Pilot light for pump running, (one for each pump).
11. Pilot light for pump failure, (one for each pump).
12. Visual indication of status and alarm for pump failure, high water and low water.
13. Fused control-circuit transformer.
14. Buzzer alarm with silencer switch.
15. Contact relay for BAS integration.
16. Pump transfer switch for manual operation standby pump.

G. Feedwater Control Sequence:

1. Boiler water-level controller starts and stops pump to maintain boiler water-level set point.
2. Pump failure, indication enabled via discharge piping flow switch.
3. Pump shut down on low water tank level condition.
4. Visual indication of pump on and off status.
5. Visual and audible alarm indication of pump failure.

H. Receiver Makeup Water Control Sequence:

1. Electric level controller operates electric control valve to maintain receiver water-level set point.
2. Visual and audible alarm indication of low and high receiver-water level.

I. Building Management System Interface: Factory installed hardware to enable building management system to monitor and display points.

1. Hardwired Monitoring Points: On/off status for each pump, failure alarm for each pump, receiver low-water-level alarm, receiver high-water-level alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before feedwater unit installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting feedwater unit performance, maintenance, and operations.

1. Final feedwater unit locations indicated on Drawings are approximate. Determine exact locations with shop drawings before roughing-in for piping and electrical connections.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install feedwater unit level on concrete base. Concrete base is specified in Division 3, and concrete materials and installation requirements are specified in Division 3.

B. Vibration Isolation: Elastomeric isolator pads with a minimum static deflection of 0.25-inch.

C. Install unit to permit access for maintenance.

D. Support piping independent of pumps.

E. Install parts and accessories shipped loose.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections 232213. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect makeup water piping and terminate over air gap fitting.

D. Install overflow drain piping to nearest floor drain.

3.4 ADJUSTING

A. Adjust boiler water-level controls to properly stage unit.

B. Set field-adjustable, makeup water.

3.5 CLEANING

A. Clean equipment internally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions.

B. Clean strainers.

3.6 CONTRACTOR STARTUP AND REPORTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Verify proper motor rotation.
4. Startup service.
5. Report results in writing.

C. Remove and replace malfunctioning units and retest as specified above.

3.7 DEMONSTRATION AND COMMISSIONING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain feedwater units.

1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintenance. The training will occur after the startup report has been provided to the owner and the trainer will provide two (2) Installation and Operations manuals for the use of the owner’s personnel during training.
2. Review data in maintenance manuals. All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

B. Demonstrate proper operation of equipment to owner’s personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control.

END OF SECTION 235300

SECTION 235600 - GAS-FIRED MAKE-UP AIR UNIT (VENTILATION UNIT)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gas fired make-up air units.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
3. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for thermostats and time clocks for placement by this section.
4. Section 23 11 23 - Facility Natural-Gas Piping: Product requirements for natural gas piping connected to gas-fired heaters.
5. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections.
6. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI Z83.8 - Gas Unit Heaters.
2. ANSI Z83.9 - Gas-Fired Duct Furnaces.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. National Fire Protection Association:

1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
2. NFPA 54 - National Fuel Gas Code.
3. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
4. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
5. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

D. Underwriters Laboratories Inc.:

1. UL 727 - Oil-Fired Central Furnaces.
2. UL 729 - Oil-Fired Floor Furnaces.
3. UL 731 - Standard for Safety for Oil-Fired Unit Heaters.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittals procedures.

B. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

C. Product Data: Submit manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

D. Manufacturer's Installation Instructions: Submit Indicate rigging and assembly.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten year manufacturer warranty for heat exchanger.

1.8 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one extra set of throwaway filters for each unit.

PART 2 - PRODUCTS

2.1 GAS FIRED MAKE-UP AIR UNITS

A. Manufacturers:

1. Modine.
2. Sterling.
3. Reznor.

B. Mechanical Configuration:

1. All unit(s) shall have right side, when looking into the discharge, access to all controls and include: furnace section(s) with 80% minimum efficiency provided by an indirect-fired heat exchanger with dimpled tube pattern for efficient heat transfer.
2. Blower section containing a supply blower and motor with bottom support to provide rigidity. The blower connection shall be flexible with 1/4" gasket to prevent sound transmission into the supply ductwork.
3. Electrical section isolated from the supply air stream including a hinged access door. Separate knock-outs shall be provided for both high and low voltage electrical connections. Provisions must be included for side access electrical connections for slab mounted units and bottom electrical connections for roof curb mounted units.
4. Downturn plenum section for downward deflection of the supply air.
5. Rainhood and birdscreen shall be pre-assembled from the factory and provided with internal baffles to prevent water entrainment in the supply air stream.
6. Roof curb shall conform the requirements listed in section 23 05 29.

C. Venting Arrangement:

1. The venting shall be a power exhausted arrangement. The unit shall be tested to insure proper ignition when the unit is subjected to 40 mile per hour wind velocities.

D. Unit Casing:

1. The unit casing shall be constructed of not less than 18 gauge aluminized steel. All exterior casing parts shall be painted with a baked-on gray-green polyester powder paint (7 mil thickness) for corrosion resistance. All access side doors shall have heavy-duty, draw light, quarter-turn latches.
2. The casing shall be double wall construction in which the standard insulation is covered by a 22 gauge aluminized steel liner. The liner shall conform to ASHRAE Standard 62-1989 Ventilation for Acceptable Indoor Air Quality.

E. Furnace Section:

1. The heat exchanger shall be made of 20 gauge 409 stainless steel tubes and headers. The thermal efficiency of the unit shall be a minimum of 80% efficient for all air flow ranges. The restrictor shall be sized to maintain the unit efficiency of 80% in the temperature range of 20°F-60°F. Each heat exchanger tube shall be individually and directly flame-fired. The heat exchanger tube shall be contoured and dimpled to provide efficient heat transfer and crimped to allow for thermal expansion and contraction. The flue collector box shall be made of 20 gauge aluminized steel.
2. The heat exchanger(s) seams and duct connections shall be certified to withstand 3.0" W.C. external static pressure without burner flame disturbance.
3. The burner(s) shall be made of the same materials as the heat exchanger with a thickness of not less than 28 gauge. Burner(s) shall have non-clogging, slotted ports with a stainless steel separator strip designed for good lighting characteristics without noise of extinction for both natural and propane gas. The burner(s) shall be located for service removal without disconnecting the main gas supply piping.
4. The bottom of the unit shall be angled for draining any condensation to the corners of the unit. The condensation shall be removed through openings in the bottom pan. The drain pan shall be constructed of 20 gauge 409 stainless steel.
5. The gas manifold(s) piping shall allow for gas piping connection on the side of the unit for slab mounted units and through the unit bottom for roof curb mounted units. The manifold(s) shall include a ground joint union for ease of servicing of the orifices without removing the burner assembly or main gas valve string.
6. The orifice shall be provided for natural gas with adjustable air shutters for controlling the primary air mixture.
7. The ignition controller(s) shall be 100% shut-off with continuous retry for natural gas.
8. The minimum gas pressure shall be between 6-7" W.C. or less for natural gas.

9. The solid state ignition system shall intermittently light the pilot each time the system is energized. Once the pilot is proven, the main gas valve shall open and allow gas flow to the main burner.
10. The unit gas controls shall be provided with the following:

    a. Electric Modulation - 0-10Vdc External Input: Allows for control of the duct furnace firing rate by a Building Management System (BMS). Utilizes an electronic modulating/regulating gas control, combination gas valve, an ignition control, modulating signal conditioner, and an inverted 0-10Vdc input signal provided by a BMS (0 Vdc being high fire and 10 Vdc being low fire). The gas controls can modulate the gas flow between 40% and 100% full fire. When the BMS thermostat (supplied by BAS contractor) is satisfied, the BMS heat contact (supplied by BAS contractor) opens to cut power to the combination gas valve which prevents gas flow to both the main and pilot burners.

11. A 1/8" manifold pressure tap shall be located after all valves to test the manifold pressure directly before the main burner orifices.
12. The unit shall be provided with a single gas control transformer to step down the supply voltage to 24V.
13. Separate line voltage and low voltage terminal strips shall be provided to prevent the unit from being miswired.
14. Automatic reset high limit switch.
15. Provide the following factory installed options:

    a. Low gas pressure switch(s) prevents the burner from firing if the inlet gas pressure is below the minimum gas pressure.
    b. High gas pressure switch(s) which prevents the burner from firing if the manifold gas pressure is above the maximum manifold gas pressure.
    c. Air flow proving which shall be an adjustable differential pressure switch to insure air flow across the heat exchanger before allowing the gas controls to be energized.
    d. A manual reset supply air fire stat shall shut the system down if the temperature at the limit switch location exceeds 200°F.
    e. A time delay relay which delays the start of the blower to allow the heat exchanger a warm-up period after a call for heat. The time delay relay shall also continue the blower operation after the thermostat has been satisfied to remove any residual heat on the heat exchanger.
    f. The unit shall be orificed for up to 2000 feet elevation above sea level.
    g. Include a supplemental 9-year heat exchanger warranty to extend the warranty on the heat exchanger against defects in material and workmanship to a full 10-years.

F. Electrical Section:

1. All electrical components shall carry UL, ETL, or CSA listing.
2. The unit shall be supplied with a disconnect switch to disconnect power to the unit for servicing. The disconnect switch style shall be dead front starter and fusible.
3. A single step down transformer shall be provided for all unit controls.

G. Blower Section:

1. The blower motor shall meet the following requirements:

    a. Single speed, TEFC, high efficiency, 460V/6ø/3 Phase.

2. The unit shall contain a single supply blower that is supported from the bottom to prevent the blower flanges supporting the weight of the motor. The blower shall be a double width, double inlet (DWDI) forward curved, belt driven, assembly with heavy duty, pillow block ball bearings and extended grease lines which include external zerk fittings for applying grease.

3. The unit shall be provided with a filter rack with 2" Farr 30/30® filters (Merv 8).
4. Dampers and Damper Controllers:

    a. All outside air dampers are ultra-low leak, Class II leakage resistance (less than 10 CFM/ft^2 at 1" W.C.) dampers with self-compensating stainless steel side seals and santoprene and galvanized steel blade seals. All return air dampers, which are used for air balancing, shall be low leak, Class III leakage resistance (less than 40 CFM/ft^2 at 1" W.C.) dampers with self-compensating stainless steel side seals and santoprene blade seals.
    b. The damper actuator shall be mounted directly to the shaft of the fresh air damper. If return air dampers are provided, a damper linkage rod shall be provided to set the positions of the opposed dampers.
    c. The damper actuator shall spring return so when power is disconnected, the damper closes the outside air opening.
    d. All two-position damper actuators shall have one normally open and one manually closed end switch to prove that the damper has opened.
    e. Air Control GB: The unit shall be provided with fresh air and return air dampers with a modulating damper motor with 4-20mA external input signal control.
    f. The unit shall be provided with the following factory installed options:

        1) A manual reset return air fire stat that shuts the system down if the temperature in the blower section exceeds 120°F.
        2) A convenience outlet with a 115V GFCI service receptacle mounted in the blower compartment for a separate 115V power supply.

H. Mounting Base:

1. The unit shall be provided with a 14 gauge, galvanized steel, combination curb and slab type mounting base with lifting and anchoring holes.

I. Accessory Control Devices:

1. The following field installed accessory control devices shall be provided with the unit:

    a. A panel mounted potentiometer for adjusting the outside air return air damper.
    b. A freezestat to shut the fresh air dampers if the outside temperature falls below the setpoint.
    c. A remote panel with four (4) indicator lights (power on, heat on, blower on, dirty filter) and one (1) three-position switch.
    d. Room thermostat and modulating discharge air thermostat.

J. Thermostats:

1. The unit shall be provided with an override thermostat, for use with the modulating discharge air stat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify space is ready for installation of units and openings are as indicated on shop drawings.

3.2 INSTALLATION

A. Install units in accordance with NFPA 90A and NFPA 90B.

B. Installation - Natural Gas Piping:

1. Connect natural gas piping in accordance with NFPA 54.
2. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
3. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.

a. Shutoff valve.
b. Pressure regulator.

C. Provide remote control panel and operating controls. Refer to Section 23 09 93.

D. Provide connection to electrical power systems. Refer to Section 26 05 03.

END OF SECTION 235600

SECTION 239900 - VARIABLE FREQUENCY MOTOR CONTROLLER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes variable frequency controllers.

B. Related Sections:

1. Section 26 28 13 - Fuses.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
4. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

D. Test Reports: Indicate field test and inspection procedures and test results.

E. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish three year manufacturer warranty for variable frequency controller.

1.9 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each air filter.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ABB.

B. Danfoss.

C. Owner approved equal.

2.2 DESCRIPTION

A. Provide enclosed variable frequency drives suitable for operating the indicated loads.

B. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control.

C. The VFD shall include a full-wave diode bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

D. Input and output power circuit switching shall be able to be done without interlocks or damage to the VFD.

E. The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 220% of rated current for up to 1 second while starting.

2.3 RATINGS

A. Rated Input Voltage: 208 or 460 volts, three phase, 60 Hertz, see drawings.

B. Motor Nameplate Voltage: 208 or 460 volts, three phase, 60 Hertz, see drawings.

C. Operating Ambient: 0 degrees C to 40 degrees C.

D. 0 to 95% relative humidity, non-condensing.

E. Elevation to 3,300 feet without derating.

F. AC line voltage variation, -10 to +10% of nominal with full output.

G. No side clearance shall be required for cooling of wall mount units and all power and control wiring shall be done from the bottom.

H. Drive shall be capable of operating a motor up to 1,000 feet away without derating or field modification.

2.4 DESIGN

A. VFD shall have an adjustable carrier frequency of 2 to 14 kHz through 60 HP.

B. Three variable-torque V/Hz patterns shall be provided with the ability to select a constant torque start pattern for each of them.

C. Adjustable acceleration and adjustable deceleration ramps shall be provided.

D. Four current limit settings shall be provided.

E. If VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: Undervoltage, overvoltage, current limit, inverter overload and motor overload.

F. The number of restart attempts shall be selectable from 0 through 10 and the time between attempts shall be adjustable from 0 through 10 seconds.

G. Provide a manual bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the drive. In the OFF position, the motor and drive are disconnected. In the LINE position, the motor is operated at full speed from the AC power line and power is disconnected from the drive, so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. Customer supplied normally closed dry contact shall be interlocked with the drives safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault.

2.5 PRODUCT OPTIONS AND FEATURES

A. Local/Hand, Stop/Reset and Remote/Auto selector switches shall be provided to start and stop the drive and determine the speed reference.

B. Provide a 24 V DC, 40 mA max, output signal to indicate that the drive is in Remote/Auto mode.

C. Digital manual speed control.

D. Lockable, alphanumeric backlit display keypad.

E. A red FAULT light and a green POWER-ON light shall be provided.

F. The drive shall be fitted with an RS 485 serial communications port and be supplied with software to display all monitoring, fault, alarm and status signals The software shall allow parameter changes to be made to the drive settings as well as storage of each controller's operating and setup parameters.

G. Two set point control interface (PID control) shall be standard in the unit. Drive shall be able to look at two feedback signals, compare with two set points and make various control decisions. If drive is not available with 2 set point control, a separate set point controller shall be provided for supply/return fan tracking control.

H. An elapsed time meter and kWh meter shall be provided.

I. The following displays shall be accessible from the control panel in actual units: Reference Signal Percent, Output Frequency, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, No Load Warning, DC Bus Voltage, Drive Temperature (% until trip) and Motor Speed in engineering units per application in percent speed.

J. Drive will sense the loss of load and signal a no load/broken belt warning or fault.

K. The VFD shall store in memory the last 8 faults and record all operational data.

L. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

M. Two programmable relay outputs shall be provided for remote indication of drive status.

N. Two programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include 0-10 V dc, 0-20 mA and 4-20 mA.

O. Two programmable analog outputs shall be provided for indication of drive status. These outputs shall be programmable for output speed, voltage, frequency, amps and input kW.

P. Under fire mode conditions the VFD shall automatically default to a preset speed.

Q. Class 20 I2 electronic motor overload protection for single motor applications and thermal mechanical overloads for multiple motor applications.

R. Protection against input transients, loss of AC line phase, short circuit, ground fault, overvoltage, undervoltage, drive overtemperature and motor overtemperature. The VFD shall display all faults in plain English. Codes are not acceptable.

S. Protect VFD from sustained power or phase loss. The VFD shall incorporate a 5 second control power loss ride through to eliminate nuisance tripping.

T. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the starter.

U. The drive shall be fitted with output line reactors to limit the rate of output voltage rise over time (dV/dt), reduce motor operating temperature and RFI and EMI.

V. Drive shall catch a rotating motor operating forward or reverse up to full speed.

W. The VFD shall have a DC link reactor to minimize power line harmonics. VFDs without a DC link reactor shall provide a 3% impedance line reactor.

2.6 FABRICATION

A. Wiring Terminations: Match conductor materials and sizes indicated.

B. Enclosure: NEMA 250, Type 1.

C. Finish: Manufacturer's standard enamel.

2.7 SOURCE QUALITY CONTROL

A. Inspect and production test each product specified in this section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

A. Install controller where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.1.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Install fuses in fusible switches.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Provide engraved plastic nameplates.

F. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.3 FIELD QUALITY CONTROL

A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.4 ADJUSTING

A. Make final adjustments to installed drive to assure proper operation of fan system. Obtain performance requirements from installer of driven loads.

3.5 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

3.6 WARRANTY

A. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

3.7 START-UP SERVICE

A. Provide factory start-up service. Coordinate with the temperature control contractor.

END OF SECTION 239900

SECTION 260503 - EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:

1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Submittal procedures.

B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

E. Sequence electrical connections to coordinate with start-up of equipment.

1.5 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

A. Manufacturers:

1. Hubbell.
2. Leviton.
3. Pass and Seymour.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

D. Cord Construction: Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for Connected Load of Equipment, Length of Cord, And Rating Of Branch Circuit Overcurrent Protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 260503

SECTION 260519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes building wire and cable and wiring connectors and connections.

B. Related Sections:

1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:

1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 16 AWG for control circuits.
5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
5. Exterior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
6. Underground Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

1.4 DESIGN REQUIREMENTS

A. Conductor sizes are based on copper.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.

B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft of length shown.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:

1. American Insulated Wire Corp.
2. General Cable Co.
3. Pirelli Cable.
4. Republic Wire.
5. Rome Cable.
6. Southwire.
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 90 degrees C.

F. Insulation Material: Thermoplastic.

2.2 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify interior of building has been protected from weather.

C. Verify mechanical work likely to damage wire and cable has been completed.

D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques - Building Wire in Raceway:

1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.

E. Special Techniques - Cable:

1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or plenum rated plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
7. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

G. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

I. Size lugs in accordance with manufacturer’s recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.4 WIRE COLOR

A. General:

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:

a. Black, red, and blue for circuits at 120/208 volts single or three phase.
b. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:

a. Black, red, and blue for circuits at 120/208 volts single or three phase.
b. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.
2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rod electrodes.
2. Active electrodes.
3. Wire.
4. Grounding well components.
5. Mechanical connectors.
6. Exothermic connections.

B. Related Sections:

1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.
2. Metal building frame.
3. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Manufacturer's Installation Instructions: Submit for active electrodes.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical.
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:

1. Material: Copper-clad steel.
2. Diameter: 3/4 inch.
3. Length: 10 feet.

C. Connector: Connector for exothermic welded connection.

2.2 ACTIVE ELECTRODES

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical.
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:

1. Material: Metallic-salt-filled copper-tube electrode.
2. Shape: Straight.
3. Length: 8 feet
4. Connector: Connector for exothermic welded connection.

2.3 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 4 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.4 GROUNDING WELL COMPONENTS

A. Well Pipe: 8 inches NPS (DN200) by 24 inches long clay tile pipe with belled end.

B. Well Cover: Cast iron or Fiberglass with legend "GROUND" embossed on cover.

2.5 MECHANICAL CONNECTORS

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.6 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Cadweld, Erico, Inc.
3. Copperweld, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.
7. Substitutions: Section 01 60 00 - Product Requirements.
8. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 INSTALLATION

A. Install in accordance with IEEE.

B. Install rod electrodes at service locations. Install additional rod electrodes to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

E. Install 4 AWG bare copper wire in foundation footing.

F. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond steel together.

G. Bond together metal siding not attached to grounded structure; bond to ground.

H. Bond together reinforcing steel and metal accessories in pool and fountain structures.

I. Install isolated grounding conductor for circuits supplying network equipment and in accordance with IEEE 1100.

J. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

K. Bond to lightning protection system.

L. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

M. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

N. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

O. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

P. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

Q. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground resistance testing in accordance with IEEE 142.

E. Perform leakage current tests in accordance with NFPA 99.

F. Perform continuity testing in accordance with IEEE 142.

G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Surface Burning: ASTM E84 and UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code and UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers, where required.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas to receive solvent cured materials.

1.11 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company.
3. O-Z Gedney Co.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Manufacturers:

1. B-Line Systems.
2. Erico, Inc.
3. Thomas & Betts Corp.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

A. Sleeves for cabling Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for cabling Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for conduits or cabling Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Stuffing Type Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Wiremold.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.

5. 3M fire Protection Products.
6. Specified Technology, Inc.
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Where fire proofing will be visible after construction, provide products as selected by the architect products from manufacturer's full range of colors.

2.7 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing and/or damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Obtain permission from Architect or Structural Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray, conduit, wireway, trough, and cabling penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons, floor plates, or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install escutcheons at finished surfaces to match surrounding surfaces.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:

1. Section 26 05 03 - Equipment Wiring Connections.
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
4. Section 26 05 53 - Identification for Electrical Systems.
5. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground More than 5 feet outside Foundation Wall: Provide rigid steel conduit. Thickwall nonmetallic conduit may be utilized where approved by the authority having jurisdiction. Provide cast metal boxes or nonmetallic handhole.

C. Underground within 5 feet from Foundation Wall: Provide rigid steel conduit. Thin-wall nonmetallic conduit may be utilized where approved by the authority having jurisdiction. Provide cast metal or nonmetallic boxes.

D. Under Slab on Grade: Provide rigid steel conduit. Thin-wall nonmetallic conduit may be utilized where approved by the authority having jurisdiction. Provide cast or nonmetallic metal boxes.

E. Outdoor Locations, Above Grade: Provide rigid steel and aluminum conduit. Provide cast metal, pull, and junction boxes.

F. In Slab above Grade: Provide rigid steel conduit and intermediate metal conduit. Thickwall nonmetallic conduit may be utilized where approved by the authority having jurisdiction. Provide sheet metal boxes.

G. Wet and Damp Locations: Provide rigid steel and aluminum conduit. Thickwall nonmetallic conduit may be utilized where approved by the authority having jurisdiction. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.

H. Concealed Dry Locations: Provide intermediate metal conduit and electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

I. Exposed Dry Locations: Provide electrical metallic tubing except where subject to damage then provide rigid steel conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:

1. Record actual routing of conduits larger than 2 inch.
2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.

C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.9 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. Allied Tube and Conduit.
2. Southwire Company.
3. Wheatland Tube Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Rigid Steel Conduit: ANSI C80.1.

C. Rigid Aluminum Conduit: ANSI C80.5.

D. Intermediate Metal Conduit (IMC): Rigid steel.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Anamet Electrical.
2. Electricflex Company.
3. Southwire Company - Alflex.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Anamet Electrical.
2. Electricflex Company.
3. Southwire Company - Alflex.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube and Conduit.
2. Southwire Company.
3. Wheatland Tube Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.

2.5 NONMETALLIC CONDUIT

A. Manufacturers:

1. Cantex.
2. Carlon-Lamson and Sessions.
3. Petroflex.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA TC 2; Schedule 40 and 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 SURFACE METAL RACEWAY

A. Manufacturers:

1. Wiremold Co. Model V700 Series.
2. Hubbell.
3. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Size: 21/32” x 3/4” x length as required.

D. Finish: Scratch resistant ivory finish.

E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.7 WIREWAY

A. Manufacturers:

1. Circle AW.
2. Hoffman.
3. Square D Company.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: General purpose or as required to match environment installed

C. Knockouts: Manufacturer's standard.

D. Size: As indicated on Drawings.

E. Cover: Hinged cover.

F. Fittings: Lay-in type with removable side.

G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.8 OUTLET BOXES

A. Manufacturers:

1. Appleton Electric.
2. OZ Gedney.
3. Raco.
4. Red Dot.
5. Thomas & Betts.
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.9 PULL AND JUNCTION BOXES

A. Manufacturers:

1. Appleton Electric.
2. OZ Gedney.
3. Raco.
4. Red Dot.
5. Thomas & Betts.

6. Substitutions: Section 01 60 00 - Product Requirements.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Hinged Enclosures: As specified in Section 26 27 16.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron or Cast aluminum.
2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: "ELECTRIC".

E. Fiberglass or Concrete composite Handholes: Die-molded, glass-fiber or concrete composite hand holes:

1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
2. Cover: Glass-fiber or concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.3 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceway.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 26 05 29.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maximum Size Conduit in Slab Above Grade: 1 inch. Do not cross conduits in slab.

L. Maintain clearance between raceway and piping for maintenance purposes.

M. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

N. Cut conduit square using saw or pipe cutter; de-burr cut ends.

O. Bring conduit to shoulder of fittings; fasten securely.

P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows or hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch size.

S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

X. Close ends and unused openings in wireway.

3.4 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights required and as indicated on Drawings.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

O. Install gang box with plaster ring for single device outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

C. Locate outlet boxes to allow luminaires positioned as indicated on reflected ceiling plan.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.6 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused openings in boxes.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Submit manufacturer’s catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.4 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Furnish materials in accordance with industry standards.

B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.

C. Letter Size:

1. 1/8 inch high letters for identifying individual equipment and loads.
2. 1/4 inch high letters for identifying grouped equipment and loads.

D. Minimum nameplate thickness: 3/32 inch.

2.2 LABELS

A. Furnish materials in accordance with industry standards.

B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.3 WIRE MARKERS

A. Furnish materials in accordance with industry standards.

B. Description: Cloth tape, split sleeve, or tubing type wire markers.

C. Legend:

1. Power and Lighting Circuits: Actual branch circuit or feeder number.
2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

D. Conduit And Raceway Markers

E. Furnish materials in accordance with industry standards.

F. Description: Labels fastened with adhesive or stencils.

G. Color:

1. 480 Volt System: Black lettering on white background.
2. 208 Volt System: Black lettering on white background.

H. Legend:

1. Medium Voltage System: HIGH VOLTAGE.
2. 480 Volt System: 480 VOLTS. HIGH VOLTAGE.
3. 208 Volt System: 208 VOLTS.

2.4 STENCILS

A. Furnish materials in accordance with industry standards.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.

C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to the following:

1. Black lettering on white background.
2. White lettering on gray background.
3. Red lettering on white background.
4. Blue lettering on white background.

2.5 UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, detectable type, colored red or yellow with suitable warning legend describing buried electrical lines.

2.6 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum or reinforced nylon hasp with erasable label surface; size minimum 7-1/4” x 3”.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.

3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using screws, rivets, or adhesive.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:

    a. Switchboards.
    b. Panelboards.
    c. Transformers.
    d. Service Disconnects.
    e. Motor Starters.

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:

1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.

E. Conduit Marker Installation:

1. Install conduit marker for each conduit 1 1/2” and larger longer than 20 feet.
2. Conduit Marker Spacing: 20 feet on center.
3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.

    a. Paint colored band on each conduit longer than 20 feet.
    b. Paint bands 20 feet on center.
    c. Color: Utilize the owners standard color coding. If no standard exists provide;

        1) 480 Volt System: Orange.
        2) 208 Volt System: Blue.

F. Stencil Installation:

1. Apply stencil painting in accordance with Section 09 90 00.

G. Underground Warning Tape Installation:

H. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards, and load centers.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 53 - Identification for Electrical Systems.
3. Section 26 28 13 - Fuses.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.
7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:

1. UL 67 - Safety for Panelboards.
2. UL 1283 - Electromagnetic Interference Filters.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.

B. Furnish two of each panelboard key.

1.7 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS - NEW

A. Material and Equipment: Product Options and Substitutions.

B. Manufacturers:

1. District Standards:

a. Square D Company.

2. Acceptable Substitution:

a. Cutler-Hammer.
b. General Electric.

C. Description: NEMA PB 1, circuit breaker type, as indicated.

D. Panelboard Bus: Copper ratings as indicated. Provide copper equipment ground bus in each panelboard.

E. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt panelboards, 14,000 amperes rms symmetrical for 480 volt panelboards.

F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

G. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

H. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

I. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

J. Enclosure: NEMA PB 1, Type 1.

K. Cabinet Front: Surface type, fastened with concealed trim clamps or screws metal directory frame, finished in manufacturer's standard gray enamel.

L. Nameplate: Provide identification nameplates indicating panelboard designation. At distribution devices indicate the designation of the equipment followed by the area served.

2.2 DISTRIBUTION PANELBOARDS - EXISTING

A. Add new thermal-magnetic circuit breaker or fusible switch type branch circuit devices to existing distribution panelboards as required.

B. All new devices shall be of the same manufacturer, type and interrupting capacity as the original equipment.

C. Provide new nameplates upon completion of all wiring. Refer to Section 16195.

2.3 BRANCH CIRCUIT PANELBOARDS - NEW

A. Manufacturers:

1. District Standards:

a. Square D Company.

2. Acceptable Substitution:

a. Cutler-Hammer.
b. General Electric.

B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, ratings as indicated. Provide copper equipment ground and neutral in each panelboard. Provide additional copper isolated ground bus where indicated.

D. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards, and 14,000 amperes rms symmetrical for 480 volt panelboards unless otherwise indicated larger on the drawings.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

F. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

G. Enclosure: NEMA PB 1, Type 1.

H. Cabinet Box: 6 inches deep, 20 inches wide panelboards.

I. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

J. Nameplate: Provide identification nameplate indicating panelboard designation.

2.4 BRANCH CIRCUIT PANELBOARDS - EXISTING

A. Circuits to existing branch panelboards shall be connected to existing circuit breakers or plug fuses when available. Verify circuit numbers shown, provide new circuit breakers and/or rearrange existing circuit breakers as required.

B. Where new circuit breakers are added to existing panelboards, rearrange or remove existing breakers as required to accommodate the new circuit breakers. Deliver unused/removed circuit breakers to Owner.

C. All new circuit breakers installed in existing panelboards shall be of the same manufacturer, type, and interrupting capacity as the original equipment.

D. Add plug fuses as required.

E. Provide revised typewritten circuit directories upon completion of all wiring.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned panelboards and load centers. Remove and Install blank cover for abandoned panelboards and load centers.

B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.2 INSTALLATION

A. Install panelboards and load centers in accordance with NEMA PB 1.1.

B. Install panelboards and load centers plumb.

C. Install recessed panelboards and load centers flush with wall finishes.

D. Height: 6 feet to top of panelboard and load center; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard and load center. Revise directory to reflect circuiting changes to balance phase loads.

G. Install engraved plastic nameplates in accordance with Section 26 05 53.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; multi-outlet assembly; and device plates and decorative box covers.

B. Related Sections:

1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

1.6 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:

1. District Standard:

a. Hubbell Model HBL1221 or HBL1221L.
b. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA WD 1, specification grade, AC only general-use snap switch.

C. Body and Handle: Ivory plastic with toggle handle.

D. Indicator Light: Lighted handle type switch where indicated on drawings.

E. Ratings: Match branch circuit and load characteristics.

F. Provide similar construction three-way and four-way switches where indicated on drawings.

2.2 WALL DIMMERS

A. Manufacturers:

1. District Standard:

a. Hubbell Model AS Series.
b. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA WD 1; Type as required to be compatible with lamps and/or ballasts.

C. Body and Handle: Ivory plastic with linear slide.

D. Voltage: To match load served.

E. Power Rating: As indicated on Drawings.

F. Accessory Wall Switch: Match dimmer appearance.

2.3 RECEPTACLES

A. Manufacturers:

1. District Standard:

a. Hubbell Model HBL5252I.
b. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA WD 1, specification grade receptacle.

C. Device Body: Decora flat face, back wired, ivory color.

D. Configuration: NEMA WD 6, type as indicated on Drawings.

E. Convenience Receptacle: Type 5-20.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

G. Provide tamper resistant receptacles in areas where students are present.

2.4 WALL PLATES

A. Decorative Cover Plate: In finished areas for switches and receptacles brushed 302 stainless steel. Provide oversized “jumbo plates” for devices on masonry walls, when required to conceal gaps.

B. Surface raceway system plate: Utilize plate specifically designed for raceway system and device.

C. Cover plate: In unfinished area provide cadmium plated steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole on bottom.

F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

H. Use jumbo size plates for outlets installed in masonry walls to conceal gaps.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 16 inches above finished floor.

D. Install convenience receptacle 6 inches above back splash of counter.

E. Install dimmer 48 inches above finished floor.

F. Coordinate installation of wiring devices with underfloor raceway service fittings provided under Section 26 05 39.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect each wiring device for defects.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify each receptacle device is energized.

E. Test each receptacle device for proper polarity.

F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.4 FUSE PERFORMANCE REQUIREMENTS

A. Main Service Switches Larger than 600 amperes: Class L time delay.

B. Main Service Switches: Class RK1 time delay.

C. Power Load Feeder Switches Larger than 600 amperes: Class L time delay.

D. Power Load Feeder Switches: Class RK1 time delay.

E. Motor Load Feeder Switches: Class RK1 time delay.

F. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.

G. Lighting Load Feeder Switches: Class RK1 time delay.

H. Other Feeder Switches Larger than 600 amperes: Class L time delay.

I. Other Feeder Switches: Class RK1 time delay.

J. General Purpose Branch Circuits: Class RK1 time delay.

K. Motor Branch Circuits: Class RK1 time delay.

L. Lighting Branch Circuits: Class G.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two fuse pullers.

1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish three spare fuses of each Class, size, and rating installed.

1.10 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers:

1. Bussman.
2. Littlefuse.
3. Ferraz Shawmut.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.

C. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

END OF SECTION 262813

SECTION 262819 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fusible and nonfusible switches.

B. Related Sections:

1. Section 26 28 13 - Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. District Standard:

a. Square D Company.
b. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

F. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. District Standard:

a. Square D Company.
b. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

E. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.

D. Install engraved plastic nameplates in accordance with Section 26 05 53.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 262819

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manual and magnetic motor controllers in individual enclosures.

B. Related Sections:

1. Section 26 28 13 - Fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations and ratings of enclosed controllers.

C. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. District Standard:

1. Square D Company.
2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MANUAL CONTROLLERS

A. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller with overload element, red pilot light, and push button toggle operator.

B. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.

C. Enclosure: NEMA ICS 6; Type 1.

2.3 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.

C. Coil operating voltage: 120 volts, 60 Hertz.

D. Overload Relay: NEMA ICS; bimetal.

E. Enclosure: NEMA ICS 6, Type 1 unless indicated otherwise or required to suit location.

2.4 PRODUCT FEATURES FOR AUTOMATIC CONTROLLERS

A. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.

B. Cover Mounted Pilot Devices: NEMA ICS 2, standard heavy duty type.

C. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150.

D. Indicating Lights: Neon type.

E. Selector Switches: Rotary type hand-off-auto. Provide additional high/low push-button type switch for 2-speed motors.

F. Control Power Transformers: 120 volt secondary, in each motor starter. Verify secondary voltage with building controls. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.5 DISCONNECTS

A. Combination Controllers: Combine motor controllers with fusible switch disconnect in common enclosure.

B. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle.

C. Fuse clips: Designed to accommodate Class R fuses.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

F. Neatly type label and place inside each motor controller door identifying motor served nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 262913

SECTION 264313 - SURGE PROTECTION FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for surge protection for low voltage electrical power circuits as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

B. Section Includes: The work specified in this Section includes, but shall not be limited to, the following:

1. Requirements for both field-mounted SPDs (externally mounted), and integrated SPDs (installed from the factory) for low voltage power distribution and control equipment.

1.2 REFERENCES

A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. ANSI/IEEE C62.41.1, “Guide on the Surges Environment in Low Voltage (1000 V and Less) AC Power Circuits.”
2. ANSI/IEEE C62.41.2, “Recommended Practice on Characterization of Surges in Low Voltage (1000 V and Less) AC Power Circuits.”
3. ANSI/IEEE C62.45, “Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.”

C. International Organization for Standardization (ISO):

1. ISO 9001, "Quality Management Systems - Requirements."

D. National Fire Protection Association (NFPA):

1. NFPA 70, "National Electrical Code," hereinafter referred to as NEC.

E. Underwriters Laboratories, Inc. (UL):

1. UL 67, "Standard for Panelboards."
2. UL 96A, "Standard for Installation Requirements for Lightning Protection Systems."
3. UL 845, "Motor Control Centers."
4. UL 857, "Busways."
5. UL 891, "Switchboards."
6. UL 1283, “Standard for Safety for Electromagnetic Interference Filters."
7. UL 1449, "Standard for Surge Protective Devices."
8. UL 1558, "Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear."

1.3 DEFINITIONS

A. $I_{(n)}$: Nominal discharge current rating.

B. MCOV: Maximum continuous operating voltage.

C. Protection Modes: The pair of electrical connections where the VPR applies.

D. MOV: Metal oxide varistor; an electronic component with a significant non-ohmic current voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 SYSTEM DESCRIPTION

A. General SPD Requirements:

1. SPD with accessories shall be listed and labeled as defined in NEC, by UL, and marked for intended location and application.
2. Comply with UL 1449.
3. Comply with UL 1283 (applies to Type 2 SPDs).
4. Design in accordance with ANSI/IEEE C62.41.1, ANSI/IEEE C62.41.2, and ANSI/IEEE C62.45.
5. SPDs manufacturer shall be ISO 9001 certified.
6. MCOV of the SPD shall not be less than 115 percent for 480Y/277V and 125 percent for 208Y/120V nominal RMS system voltages.
7. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

    a. Panelboards: UL 67.
    b. Motor Control Centers: UL 845.
    c. Busway: UL 857.
    d. Switchboards: UL 891.
    e. Switchgear: UL 1558.

1.5 SUBMITTALS

A. General: See Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1. For each type of product indicated include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Provide verification the SPD is listed or recognized through UL to the latest safety standard, UL 1449.

C. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer’s standard product data.

D. Operation and Maintenance Data: Submit operation and maintenance data for surge protection for low voltage electrical power circuits to include in operation and maintenance manuals.

E. Warranty Data: Submit sample of special warranties.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of surge protection for low voltage electrical power circuits of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.
2. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing surge protection for low voltage electrical power circuits similar in type and scope to that required for this Project and shall be approved by the manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Single Source Responsibility: Obtain surge protection for low voltage electrical power circuits and required accessories from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work. Any materials which are not produced by the manufacturer shall be acceptable to and approved by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 WARRANTY

A. General: See Section 01 77 00 - Closeout Procedures.

B. Special Warranty: Submit a written warranty executed by the manufacturer, the Installer, and the Contractor, agreeing to repair or replace surge protection for low voltage electrical power circuits that fail in materials or workmanship within the specified warranty period.

1. Warranty Period: Warranty period shall be 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Product specified is "Surgelogic Surge Protection" as manufactured by Square D by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. SPDs: Comply with UL 1449.

1. SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the service entrance OCPD shall be either Type 1 or Type 2 SPDs.
2. Type 2 SPDs shall also comply with UL 1283.

B. Features and Accessories: SPDs shall provide the following features and accessories:

1. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
2. Indicator light(s) display for power and protection status with push-to-test capabilities.
3. Audible alarm with silencing switch.
4. Form C contacts; one normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter with reset switch.
6. Optional integral disconnect switch for externally mounted SPDs. SPDs integrated into factory supplied equipment shall have an input disconnect switch or circuit breaker unless indicated on the equipment drawings/data sheets.

C. Surge Current Rating:

1. The surge current rating of the SPD shall be dependent of its category/location, as follows:

Category/Location	Application	Per Phase	Per Mode
C	Service Entrance	240 kA	120 kA
B	Distribution	160 Ka	80 kA

D. Protection Modes:

1. UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 volts	1200 volts	1500 volts
L-L	1200 volts	2000 volts	2500 volts

2. UL 1449 VPR for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 volts	2000 volts	2500 volts

E. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

F. Nominal Discharge Current Rating: 20 kA I(n).

1. Surge protective devices located at service entrance locations shall carry a minimum nominal discharge current rating of 20 kA to meet the requirements of UL 96A.

2.3 DISTRIBUTION/ BRANCH PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449.

1. Type 1 or Type 2 SPDs.
2. Type 2 SPDs shall also comply with UL 1283.

B. Features and Accessories: SPDs shall provide the following features and accessories:

1. Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.
2. Indicator light(s) display for power and protection status.
3. Audible alarm with silencing switch.
4. Form C contacts; one normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter with reset switch.
6. Optional integral disconnect switch for externally mounted SPDs. SPDs integrated into factory supplied equipment shall have an input disconnect switch or circuit breaker unless indicated on the equipment drawings/data sheets.

C. Surge Current Rating:

1. The surge current rating of the SPD shall be dependent of its category/location, as follows:

Category/Location	Application	Per Phase	Per Mode
B	Distribution	160 kA	80 kA
B	Branch	120 kA	60 kA

D. Protection Modes:

1. UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 volts	1200 volts	1500 volts
L-L	1200 volts	2000 volts	2500 volts

2. UL 1449 VPR for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 volts	2000 volts	2500 volts

E. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

F. Nominal Discharge Current Rating: 10 kA I(n).

2.4 ENCLOSURES

A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on drawings.

1. Indoor Enclosures for Externally Mounted SPDs: NEMA 250, Type 3R.
2. Outdoor Enclosures for Externally Mounted SPDs: NEMA 250, Type 3R, 4X.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

A. Install surge protection for low voltage electrical power circuits in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.

B. Install SPD devices at the service entrance in accordance with NEC. SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the OCPD shall be either Type 1 or Type 2 SPDs.

C. Follow manufacturer’s recommended installation practices.

1. Provide a minimum 30 ampere circuit breaker as a dedicated disconnecting means for the SPD unless otherwise indicated.
2. Install SPDs with properly rated conductors between suppressor and points of attachment as short and straight as possible; adjust circuit breaker positions to achieve shortest and straightest leads.
3. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
4. Twist input conductors together to reduce the input inductance.

3.3 FIELD QUALITY CONTROL

A. See Section 01 45 23 - Inspecting and Testing Services.

B. Perform the following tests and inspections.

1. Compare equipment nameplate data for compliance with the Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. A SPD will be considered defective if it does not pass inspections.

D. Prepare inspection reports.

3.4 DEMONSTRATION

A. Start-Up Service:

1. Complete start-up checks according to manufacturer's written instructions.
2. Do not perform insulation resistance tests of the distribution wiring equipment with SPDs installed. Disconnect all wires, including, but not limited to, neutral of the SPD before conducting insulation resistance tests, and reconnect them immediately after the testing is over.
3. Energize SPDs after power system has been energized, stabilized, and tested.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the installer that shall ensure that the surge protection for low voltage electrical power circuits shall be without damage at time of Substantial Completion.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

B. Related Sections:

1. Section 09 58 00 - Integrated Ceiling Assemblies.
2. Section 23 37 00 - Air Outlets and Inlets: For interface with air handling fixtures.
3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

C. Product Data: Submit dimensions, ratings, and performance data.

D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two of each ballast type.

1.7 REGULATORY REQUIREMENTS

A. Conform to Health/Life Safety Code for Public Schools.

B. Conform to (IMC) International Mechanical Code. (2009)

C. Conform to (IBC) International Building Code. (2009)

D. Conform to (IFC) International Fire Code, excluding Chapter 4. (2009)

E. Conform to State of Illinois Plumbing Code. (2014)

F. Conform to Illinois Accessibility Code. (71 IL Adm. Code 400)

G. Conform to (IECC) International Energy Conservation Code. (2012)

H. Conform to (IFGC) International Fuel Gas Code. (2009)

I. Conform to (IPMC) International Property Maintenance Code. (2009)

J. Conform to Illinois State Fire Marshal's Boiler and Pressure Vessel Safety. (41 IL Adm. Code 120)

K. Conform to (ICC) International Code Council Reference Standards. (2009)

L. Conform to (NFPA) National Fire Protection Association 70 National Electrical Code. (2008)

M. Products: Listed and classified by Underwriter's Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

B. Refer to Section 01 60 00 - Product Requirements for product options.

2.2 FLUORESCENT BALLASTS

A. Manufacturers:

1. Osram Sylvania.
2. Advance.
3. Universal.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Electronic ballast, rapid start less than 10 percent THD suitable for lamps specified, with voltage to match luminaire voltage. Reference lighting fixture schedule for specific ballast requirements.

C. All ballast shall be universal voltage type, suitable for 120 and 277 volt operation.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

A. Manufacturers:

1. Osram Sylvania.
2. Advance.
3. Universal.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: ANSI C82.4, metal halide or high pressure sodium lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.4 FLUORESCENT LAMPS

A. Manufacturers:

1. Philips.
2. Osram Sylvania.
3. GE Lighting.
4. Substitutions: Section 01 60 00 - Product Requirements.

B. The lamp color temperature shall be 5000K color temperature.

2.5 HID LAMPS

A. Manufacturers:

1. Philips.
2. Osram Sylvania.
3. GE Lighting.
4. Substitutions: Section 01 60 00 - Product Requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide a coordinated layout of all gymnasium lighting fixtures and submit to construction manager for review and approval prior to rough-in.

B. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.

C. Support luminaires independent of ceiling framing.

D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan drawings.

E. Install pendant and surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

F. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure. Install auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.

G. Install recessed luminaires to permit removal from below.

H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Install clips to secure recessed grid-supported luminaires in place.

J. Install wall-mounted luminaires at height as indicated on Drawings or as scheduled.

K. Install accessories furnished with each luminaire.

L. Connect grid mounted luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.

M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

N. Install specified lamps in each luminaire.

O. Operate T-5 fluorescent lamps at full intensity for 100 hours or the recommended time from the manufacturer to “Burn-in” or “Season” lamps.

P. Interface with air handling accessories furnished and installed under Section 23 37 00.

Q. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Aim and adjust luminaires as indicated on Drawings.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION 265100